

Nonster New Airship Will Carry Passengers across the Continent Rich Rewards for Arctic Pioneers—By Stefansson

A.NUARY Is Oil for House Heating Cheaper than Coal? (Page) 25 CENTS





Could you tell this story?

Music may be just a succession of pleasant sounds—or infinitely more than that. It may tell a fine romantic story or it may portray some spiritual struggle that you yourself have experienced.

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POPULAR SCIENCE MONTHLY

JANUARY, 1923; Vol. 102, No. 1 25 cents a Copy; \$2.50 a Year



Published in New York City at 229 West Thirty-ninth Street

Help Save Radio!

ON THE grounds of a charming country lodge in a little Virginia town there stands a queer looking loudspeaker, made of stone and cement. When concerts from broadcasting stations are on the air, strains of superlative music float out over the countryside from the mouth of this great horn, and are enjoyed by willness.

and are enjoyed by villagers a mile or more away!

Armstrong Perry tells in the next issue of POPULAR SCIENCE MONTHLY how he discovered this loudspeaker and its remarkable inventor.

IN THE same issue, Dr. M. I. Pupin, famous inventor and professor at Columbia University, will tell of a wonderful new project to broadcast a college education for the benefit of millions who are now denied the advantages of a university course.

Christmas, 1922, has been called "the first radio Christmas." Radio receiving sets have come to the fore among the most desirable gifts. At the suggestion of Popular Science Monthly, plans were being made as this issue went to press for nationally broadcasting on Christmas Eve the old Christmas carols.

ELSEWHERE in this issue you will read how the activities of a thousand snow-bound workers on a great Los Angeles water supply project are being directed by radio. At the suggestion of Populas Science Monthly, a special Christmas radio entertainment has been arranged for these men, marconed for months in the mountain fastnesses.

Now-inn't your Imagination fired by the variety of such practical applications of radio as those sketched above? But, wonderful as these possibilities of radio are, the development of wireless broadcasting today as a great new institution of public service is seriously hampered-simply for lack of Federal legislation. Whether radio is to remain in its present state of confusion, or to realize fully the tremendous opportunities POPULAR SCIENCE which MONTHLY has for a year and a half predicted, will partly depend on public opinion.

Your aid is needed to help save broadcasting from its present difficulties. Read the editorial note on page 28 of this terms, telling what YOU can do

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POPULAR SCIENCE MONTHLY

I word monthly. Single 1089, no cents. Fearly subscription to United States, its processions, and Canada, \$2, 50; foreign countries, \$3.

Entered as second-class matter Dec. 46, roof, at the Post Office at New York under the act of March 3, 1870. Entered as menud-class matter at the Post Office Department, Canada. Printed in U. S. A.

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H. J. Fisher, President R. C. Wilson, Fice-Persident
G. B. Cagen, Secretary and Treasures

Health in Your Home

SELDOM has a magazine article created more immediate and widespread interest than one in last month's issue of Popular Science Monthly by Harry A. Mount, entitled, "Why Our Homes Breed Winter Sickness." Mr. Mount explained astonishing health facts—long known to science, but

hitherto ignored by the public —concerning the importance of humidity in the air we breathe, and suggesting effective methods of preventing colds and even more serious illness.

Mr. Mount's article has won the commendation of leading national authorities on ventilation and health, among them E. Vernon Hill, of Chicago, noted specialist in heating and humidifying apparatus, who writes;

"The discussion in POPULAR SCIENCE MONTHLY of the real meaning of humidity in its relation to temperature, is desirable and timely. Every householder should obtain a practical wet bulb thermometer, to make a diagnosis of air conditions in his home,"

MR. E. P. LYON, dean of the Medical School of the University of Minnesota, writes

"I have locked over the article on humidity in your December issue. I agree with you that this is a very important topic. Any humidity device, to be really useful, must be automatic, since an ordinary house may take from 15 to 20 gallons of water a day, and no housewife is going to carry that amount to hand-filled humidifiers."

An Ideal Gift for a Man

THERE is one Christmas gift that will bring more pleasure, will give more valuable ideas, will be more appreciated than anything costing three or four times as much.

It will be used and enjoyed during the whole of next year. It will bring every month new ideas, new inspiration.

It is Popular Science Monthly for 1923.

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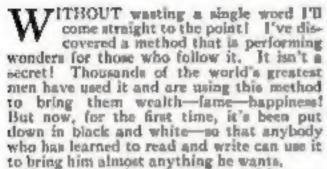
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By A. L. Pelton

"The Man Who Helps People Succeed"



No longer need you be content with an ordinary job at an ordinary salary! Here's a new, easy, positive way to achieve the kind of success you have siways wanted! I'll show you how to acquire the remarkable power to do the work you like and earn more money than perhaps you ever dreamed of, and I absolutely guarantee that it will bring at least \$1,000 value the first year-or it won't cost you a cent!

Let me repeat-it isn't a secret. It's been used thousands of times. Only now it's put

down on paper, in plain every-day English so anybody with ordinary intelligence can follow it and make a great deal of money! If you want to know how this method works let's take some actual examples.

A Few Actual Examples

John Watson was born "helpless in body," and has never been able to walk a step. His parents were poor. He had very little schooling. Yet, despite his handicaps, Watson-that's not his real name, although every word here is true-has become a very rich man. He owns a huge factory in Louisville, Kentucky, and is consulting engineer for many concerns at \$100 an bour! Only recently he turned down g \$40,000 a year job. He's a wonder(ul artist, an orator, an inventor and a lawyer. He had only a brain to start with, yet he has won great wealth, fame and happiness!

You may think Wetson was a grain. Then how about Wrigley, the chewing gum king? He started as a poor newsboy in Chicago and now makes many times more money in a day than thousands of people earn in a year! How about Douglas the milliongire shoeman who was a shoemaker's helper? I could mention thousands of others.

Read your history and you'll find that the very men you know best-Napoleon, Grant, Lincoln, and countless others-became famons by using this simple method. Yet you, too, possess the magic that made millions for Rockefeller, Vanderlip, Sabin, Schwab and Edison! The case with which you'll climb in business and in private life will seem almost miraculous once you learn to use it.

Anyone Can Use It

You don't need to have a college education to use this method to great advantage. If you can only read and write you have the proper qualifications to make this marvelous discovery unlock the doors to the world's greatest treasures! You can learn it in a surprisingly short time. And the minute you learn it, you become more forceful, persuasine, confident. You think better, cleurer, quicker. Your success becomes rapid—sure—easy. You'll astonish your friends and yourself

Today thousands of men and women are using this method to bring them wealth, power, happiness. Results are astounding! Clerks are becoming executives almost over night. Salesmen are doubling and tripling their commissions. It's a definite - sure way,

Adding twenty, thirty, or forty, even a bundred dollars a week to a man's salary is not at all unusual. This new method for success cannot fail if carefully followed. That's why I absolutely guaranter you \$1,000 value the very first year!

Will you let me show you the easiest way in the world to get the things you want? don't care what you wantwhether it be money, health, power, fame, happiness! I'll show you how to get it! You won't guess—you'll know. In plain every day language you'll be led step by step over all the obstacles that have held you back. You will be brought into a new landwhere success is positive! You'll feel like a blind man who has just regained his eyesight! You lose your fears -worries-timidity, You atquire a lion's courage. Nothing daunts you - nothing stops you. The door opensyou enter and help yourself!

How It Works

The method is simple, too. One of the greatest psychologists the world has ever known, Prof. Frank Channing Haddock, has discovered, after years of patient research and study, certain things about success. He found that out of thousands of successful men and women, practically every one possessed certain fundamental characteristics or qualities which were directly responsible for their success. He found that once a person acquired such qualities as foresight, imagination, willpower, confidence, fearlessness, and thiolong



ability - his succens la life was absolutely certain.

important than this was the astonishing discovery of how say man or woman could early and quickly and positively develop these ch aracteristics. his whole method is embodied in his "Mastery of Self," which already has performed thousands upon thousands of seeming miracles in bringing the people the success they have always longed for,

Free Book Tells How

I wish I had space enough to tell you all the wonderful things "Mustery of Self" has done for thousands of people.

But of contract it is impossible, so we have written a new booklet—"The Power That Compets Success"—which is chock-full of all the things you want to know. This book will be a revelation to you. It will show you how to double your power of accomplishment—how to double your about to think—how to barish your fears, self-consciousness, wordes, thaidlity, how to acquire the consciousness, wordes, thaidlity, how to acquire the consciousness. This remarkable book is absolutely free Send for it now. It may mean the turning point in your life. It will show you the new case was to greater health—wealth—and impositors it Mail the compon today. And remember my guarantee of at least \$1,000 value the very first year. But of course it is

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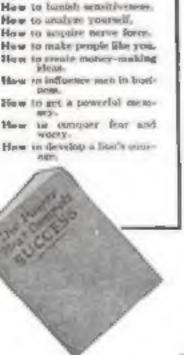
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Would Be Worth \$100,000

"H I had only had it when I was 20 years old, would be worth \$100,000 today."—E. W. Taylor, The Santa Fe Rys, Milano, Tex.



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How to attract success.

In Next Month's Issue of Popular Science Monthly

An Advance Showing of a Few of the Fascinating Features to be Unreeled in Our February Pages

The "Deadly" Tarantula

WOULD you have the nerve de-V liberately to force a "deadly" tarantula—that dreaded spider nearly as large as a man's hand -to nip your finger in order to test the supposed fatal effects of its poison? A college professor recently tried just such an experiment on himself.

In next month's issue you'll read the dramatic story of his test, and evidence that spiders are not enemies of man, but rather his servants.

What an Ice Storm Did

THE strange looking "ropes" at the right are ice incrusted telephone wires that went down during a sleet storm. Have you ever realized the astonishing damage that a beautiful winter ice storm can do? And do you know how telephone companies instantly locate and repair breaks in the lines? Read all about it next month.

Three Thousand Pictures a Year

N THE motion picture strip on I this page you glimpse just a few of the scores of fascinating features IB POPULAR SCIENCE MONTHLY for February. In fact, every issue of Popular Science Monthly is a movie news reel of the world's events. No less than 3000 pictures are published yearly in the magazine. It is the one indispensable publication for the live-wire man.

Why not insure yourself against missing a copy by subscribing now?

Use the coupon below.





Every Issue of POPULAR SCIENCE MONTHLY is a complete real of pictures giving you the important news of the world of science and invention

Is Your Home Fireproof?

WILL your home be one of the 1600 that "go up in smoke" every week? should start in one of your rooms, what would happen? In the burning building shown above at left a roaring fire was confined to a single room for an hour, simply because the walls were properly fireproofed.

An article in our next issue will tell you how you can protect your home from fire at a reasonable cost.

Uncle Sam Builds "Mother" Ships for Airplanes

YOU'LL notice that the airplane at the left is not flying, but is suspended by hooks under a "parent" balloon. Uncle Sam's plans for building new mother ships to act as floating bases for squadrons of airplanes are described in the Febfuary issue.

A Record Cloudburst

AN you imagine a cloudburst so colossal as to create a wall of water 60 feet high? Read next month a dramatic eyewitness story of the greatest cloudburst in history that swept Sand Canyon in southern California, carrying a 640-acre pasture bodily for nine miles down to the Mojave Desert.

Carrollist Indiana

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At Last-Successful Color Movies

UST a year ago David Wark Griffith, world famous motion picture producer, told POPULAR SCIENCE MONTHLY readers that what the movies most needed was realistic color. Popular Science Monthly next month tells how this need has been successfully met at last by a marvelous new invention, and how the first successful color movies were produced. Another article in the same issue will reveal startling new departures in theater design.

It's a Shame for You Not to Make Big Money

-When Others Do It So Easily



He Does It "Last week my agra-ings amounted to \$554.37; this week will go over \$408."— F. Wynn, Pertland, Ore.

THEN a farmhand steps from \$50 to \$1,000 a month-when a fireman jumps from \$60 a month to a job paying him \$500 for two weeks' work-when a former railway mail clerk, at a yearly salary of \$1,600, changes his job and earns \$1,000 in thirty days -and when hundreds of others quickly jump from small pay to magnificent earnings in the same way—then it's a shame for you not to do equally as well.

There is nothing exceptional about these men. They'd tell you that themselves. Many had been clerks, bookkeepers, mechanics. Some had been policemen, farmhands, firemen. And then in one swift stroke they found themselves making more money than they had ever dreamed

possible. The grind of routine work-the constant struggle to obtain even a small increaseall this was left behind. To-day they know the thrill of making big money; they are no longer ruled by an office clock. There is genuine enjoyment in every hour of the day, for their work is filled with real fascination. They have found not only the most interesting, but the best paying, branch of all business.

A field that they had never dreamed of as theirs they found to be easy and uncrowded. Earnings that they had always hoped to reach and that their old jobs could neer have paid, were right there in this new field waiting for them. Hundreds of others have found success the same way. You can too-let us tell you how,



So Does He "I have never sarned more than \$40 a month. Last week I cleared \$306 and this week \$218,"-- George W. Kenras, Oklahoma City, Okla.

How You Can Do It Too

What these men have done, hundreds of others have done, hundreds are doing to-day, hundreds will do to-morrow. And you can be one of them! For now the same opportunity that put these men into the big-money class is open to you!

In the first place, they discovered a vital fact about business. They discovered that the big money is in the Selling end of business. In the second place, they discovered a new and amazingly easy way that will make any man of average intelligence a Salesman, no matter what job he held before.

Salesmen are the very life-blood of any concern—upon them depends the amount of profits made. The men who can put a product on the market and boost its sales are absolutely indispensable. No wonder that man for man Salesmen receive the highest pay. For the men who are Masters of Salesmanship-there is practically no limit to their earnings-except the limit they set themselves. And that is how these men and hundreds of others like them found the

way to their present handsome incomes. They are all Master Salesmen now!

Yet previously they had no idea of becoming Salesmen. If you had told them success awaited them in the field of Selling, they would have laughed at you. They would have told you that it was absurd to think of it-for they had never sold a dime's worth of goods in their lives. Then they learned of a great organization of top-notch Salesmen and Sales Managers formed for the great opportunities in the field of Salesmanship and to help them to positions in the lines that most appeal to them. Step by step —in their spare time at home—this great organization, the National Salesmen's Training Association, took them through every phase of selling. Every underlying principle of salesmanship was made as simple as A-B-C. Then as soon as they were qualified and ready, the Free Employment Service of this Association helped them secure good Selling positions. Almost before they realized it they were in the bigmoney class.



"The very first Month I served \$1,000. I was formerly a farmhand." —Charles Berry, Winterest, 1g.

-And He

"After spending ten years to the railway mail service at salesies ranging from 3900 to \$1,600 year I decided it was nec-easary for me to make a change. My sarnings during the nest thirty days the past thirty days were more than \$1,000."—W. Hartle, Chicago, Ille.

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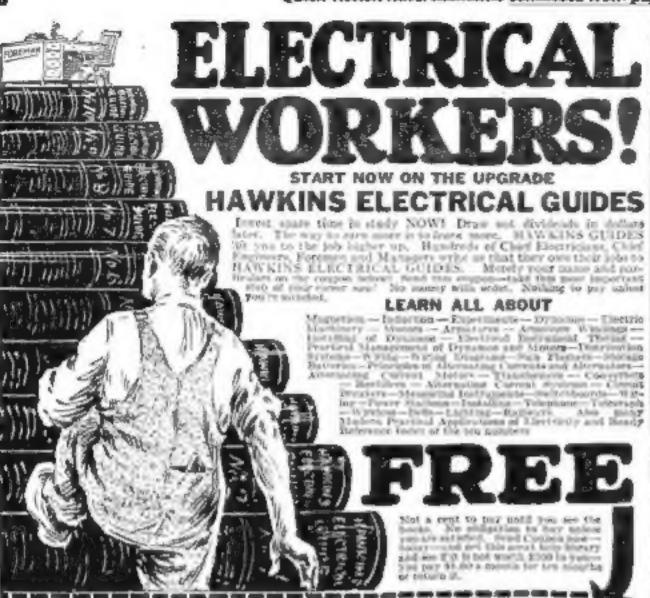
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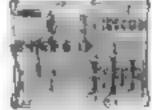
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Do You Want a Bigger Salary?

T doesn't matter what you are To-day or what you were Yesterday. To-I morrow is your bright, clear day of Opportunity. Nothing can keep you down if you really make up your mind to go up.

Maybe you've gotten a bad start. Perhaps you haven't had a decent raise in years. Or perhaps you are among those countless thousands of men who are drifting along in small jobs when with just a little training they might bring large success within their grasp

But you aren't going to curl up and quit, are you? Right now, when trained men are in such demand, you've the best chance you ever had to get out of the rut and do something worth while

But you're "too old to start over." you may. Nonsenne! When some of the big men of this country were your age, they weren't earning half what you are get-ting to-day. But they didn't quit. They worked! They studied! They learned to do some one thing well.

At 35, Henry Ford was working in the mechanical department of the Edison Electric Light & Power Company. At 88, John H. Patterson, who founded the National Cash Register Company, was the proprietor of a small and none too successful country store. At 25, George Eastman, president of the Eastman Kodak Company, was a bookkeeper in a savings bank. At 22, Edison was a roaming telegraph operator -aut of a job-too poor, when he arrived in New York, to buy his own breakfast!

You Can Get Ahead, Too

Forget what you are to-day and de-cide on what you want to be. No man has failed until he admits it to himself And no real man ever admits it. Why, men, in just one hour a day-in the spare time you will never miss-you can ilt yourself for a better job and a bigger salary.

What do you want to be? An Automotive Engineer? The vice-president In charge of engineering of the Packard Motor Car Company is an I. C. S. student. A Ship Builder? The world's greatest ship builder is an I. C. S. student. An Architect? The Equitable Building in New York, and many others were built by L. C. S. students. A Mochanical, Electrical or Civil Engineer? An L. C. 8.-trained engineer has just written to us that his Income has been increased to \$25,000 a year

Do you want to advance in Advertising? In Salesmanship? Many of the country's foremost Advertising and Sales Managers have won success through L C. S. training.

Accounting? Business Law? Business Management? All over America, bookkeepers, accountants, office managers, private secretaries are reaping the rewards of time invested in L. C. S. training in these subjects.

Do These Positions Sound Good To You?

Are you afraid to take the same chance these men took-and get the same opportunity to make good that they did? They were in worse jobs than yours. Some of them had no schooling beyond a few grammar grades. But they forgot about what they were—and they thought about what they wanted

Get out of the rut, and get out to-day. You've got it in you to make good in a big way if you will only learn to do come one thing well.

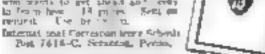
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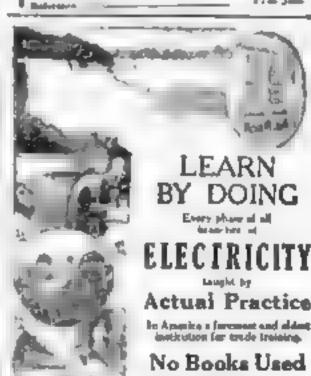
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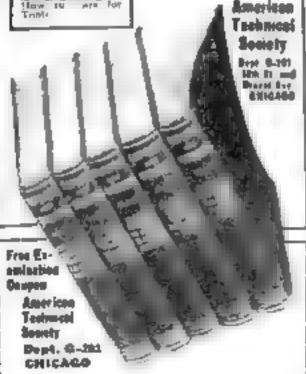
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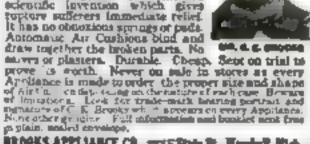
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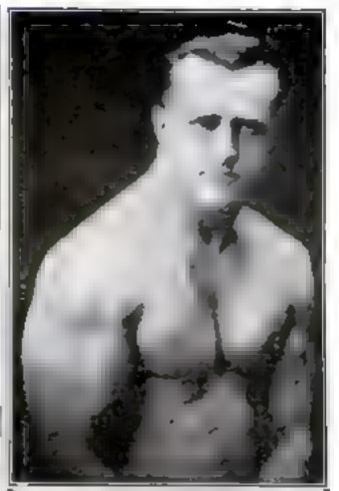
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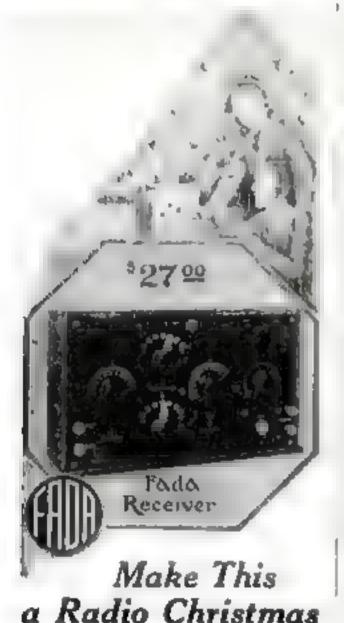
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NERVE EXHAUSTION Shell-Shocked in Every-Day Life

By PAUL von BOECKMANN

Lacture and Author of numerous backs and treatises on Mental and Physical Energy, Respiration, Psychology, Served Science and Nurse Culture

HERE is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. It is HELL; no other word can express it. At first, the ve tim is afraid be will die, and as it grips him deeper, he is afraid he will not die; so great is his mental torture. He becomes panie-stricken and irresolute. A sickening sensation of weakness and helplessness overcomes him. He becomes obsessed with the thought of self-destruction.

Nerve Exhaustion means Nerve Bankcuptey. The wonderful organ we term the Nervous System consists of countless miltons of celas. These cells are reservoirs which store a mysterious eperay we term Nerve Force. The amount stored represents our Nerve Capital. Every organ works with all (to might to keen the supply of Nerve Force in these cells at a high level, for Life Itself depends more upon Nerve Force than on the lood we eat or even the air we breathe.

If we unduly tax the nerves through overwork, worry, excitement, or grief, or if we subject the muscular system to excessive strain, we consume more Nerve Force than the organs produce, and the natural result must be Nerve Exhaustion.

Nerve Exhaustion is not a malady that comes suddenly. It may be years in developing and the decline is accompanied by unmistakable symptoms which, unfortunately, cannot readily be recognized The average person thinks that when his hands do not trensble and his muscles do not twitch, he cannot possibly be nervous. This is a dangerous assumption, for people with hands as solid as a rock and who appear to be in perfect health may be dan gerously near Nerve Collapse.

One of the first symptoms of Nerve Exhaustion is the derangement of the 5ympathetic Nervous System, the nerve beanch which governs the vital organs (see diagram). In other words, the vital organs become aluggish because of insufficient supply of Nerve Energy. This is manifested by a cycle of weakspees and disturbances in digestion; constinution, poor blood circulation and general muscular lassitude usually being the first to-be noticed.

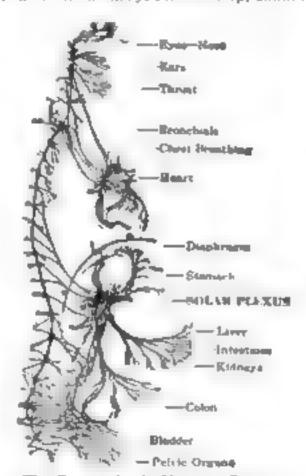
I have for more than thirty years studied the health problem from every angle. My investigations and deductions always brought me back to the immutable truth that Nerve Derangement and Nerve Weakness is the basic cause of nearly every bodily ailment, pain or disorder. I agree with the noted British authority on the nerves. Alfred T. Schofield, M.D., the author of numerous works on the subject, who says. It is my bekef that the greatest sage factor in the maintenance of health is that the nerves be in order."

The great war has taught us how frail the nervous system is and how sensitive it is to strain, especially mental and emotional strain. Shell Shock, it was proved, does not injure the nerve fibres in them-The effect is entirely mental. Thousands lost their reason thereby, over tits cases from New York alone being in asylums for the insane. Many more thousands became nervous wrecks. The

strongest men became paralyzed so that they rould not stand, eat or even speak One-third of all the hospital cases were "nerve cases," all due to excessive strain of the Sympathetic Nervous System.

The nule-a-minute life of today, with its worry, hurry, grief and mental tension as exactly the same as Shell Shock, except that the shock is less forcible, but more prolonged, and in the end just as disastrous. Our crowded insane asylums bear witness to the truth of this statement. Yme people out of ten you meet have frazzled nerves.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you; that every organ is perfect. But you know there is something the matter. You feel it, and you act it. You are tired dixxy, cannot sleep, cannot



The Sympathetic Nervous System Showing book Every Viled Organ in governed by the Harman System, and had the Solve Phasia commonly Inverse as the Abdominal brain, to the Great a great of System for the distribu-tion of Newto Power

digest your food and you have pains here and there. You are told you are "run down" and need a rest. Or the doctor may give you a tonic. Leave herve tonics none. It is like making a tired horse run by towing him behind an automobile

Our Health, Happiness and Success in life demands that we face these facts understandingly. I have written a furpage book on this subject which teaches how to protect the nerves from everyday Shell Shock. It teaches how to soothe, calmand care for the nerves, bow to nourish them through proper breathing and other means. The cost of the book is only 25 cents. Remit is coin or stamps. See address at the bottom of page. If the book does not meet your fullest expectations, your money will be refunded,

plus your outlay of postage

The book, erve Force," solves the problem for you and will enable you to diagnose your troubles understandingly.

The facts presented will prove a revelation to you, and the advice given will be of incal culable value to you.

You should send for this book today. It is for you, whether you have had trouble with your nerves or not. Your nerves are the most precious possessed you have. Through them you experience all that makes hie worth living, for to be dull nerved means to be dull brained, insenable to the higher phases of life—love, moral courage, ambition and temperament. The finer your brain is, the finer and more delicate is your nervous system, and the more imperative it is that you care for your nerves. The book is e-pecially important to those who have "high strung" nerves and those who must tax their nerves to the limit

The following are extracts from letters from people who have read the book and were greatly benefited by the teachings set forth thereig

"I have gained 12 pounds since reading your book and I feel so energetic. I had about given up hope of ever finding the

I have been treated by a number of nerve specialists, and have traveled from country to country in an endeavor to restore my nerves to normal. Your little book has done more for me than all the other methods

'Your book did more for me for indigestion than two courses in dieting.

"My heart is now regular again and my nerves are fine. I thought I had heart trouble, but it was simply a case of abused nerves. I have reread your book at least ten times,"

A woman writen: "Your book has helped my nerves wonderfully. I am sleeping so well and in the morning I feet so rested,"

The advice given in your book on relaxation and calming of nerves has cleared my brain. Hefore I was half disay all the time." A physicum says: "Your book shows you

have scientific and profound knowledge of the perves and nervous people. I am recom-A prominent lawyer in Ansonia, Conn., says Your book saved me from a nervous

cohapse such as a hat three years ago to now steep soundly and am gaining weight I can again do a real day's work '

The Prevention of Colds

Of the various books, pamphlers and treatmen which I have written on the subject of health and efficiency more has a tracted more taxorable comment than ny myteen page bookset entitled. The Prevention of Colds.

There is no human being absolutely im-mane to Colds. However, people will breathe correctly and deeply are not easily susceptible to Colds. This is clearly explained in my book NERVE FORCE. Other in portant factors, nevertheless, play an imfactors that concern the matter of ventilation, clothing, humidity, temperature, etc. These factors are fully discussed in the booklet Prevention of Colds.

Yo ailment is of greater danger than an "ordinary cold," as it may lead to Influence, Groupe, Pneumonia or Tuberculous. More deaths resulted during the recent "Fla" opidemic than were killed during the entire war, over 6,000,000 people dving in India alone,

A copy of the booklet Prevention of Colds will be sent Free upon receipt of 25c with the book Nerve Force. You will agree that this alone is worth many times the price asked for both books Address

PAUL von BOECKMANN Studio 168, 110 West 40th St., New York

Where Radio Brings Cheer to Snowbound Workmen



From an actual photograph of one of the five radio hute where opecial boliday entertainments, broadcasted from Los Angeles stations, art en-joyed by 1000 men in construction crews of the Southern California Edison Company, anowbound in the high Sterras

snowbound

ADDIDED SEC-

ICTURE a cluster of rude shacks almost buried in snowdrefts at a bleak, isolated apot nearly 10,000 feet above sea level in the enow-capped Sierra Madro Mountains of California. It is Christmas Day.

Suddenly the door of one of the shacks opens, and from within comes the blare of a band striking up a lively tune. Rough valess of rough men chime in. Radio has flung a world of cheer upward through the air to this pinnacle of desolution-and has made it sing!

That answ-imprisoned cluster of shacks

Concert star

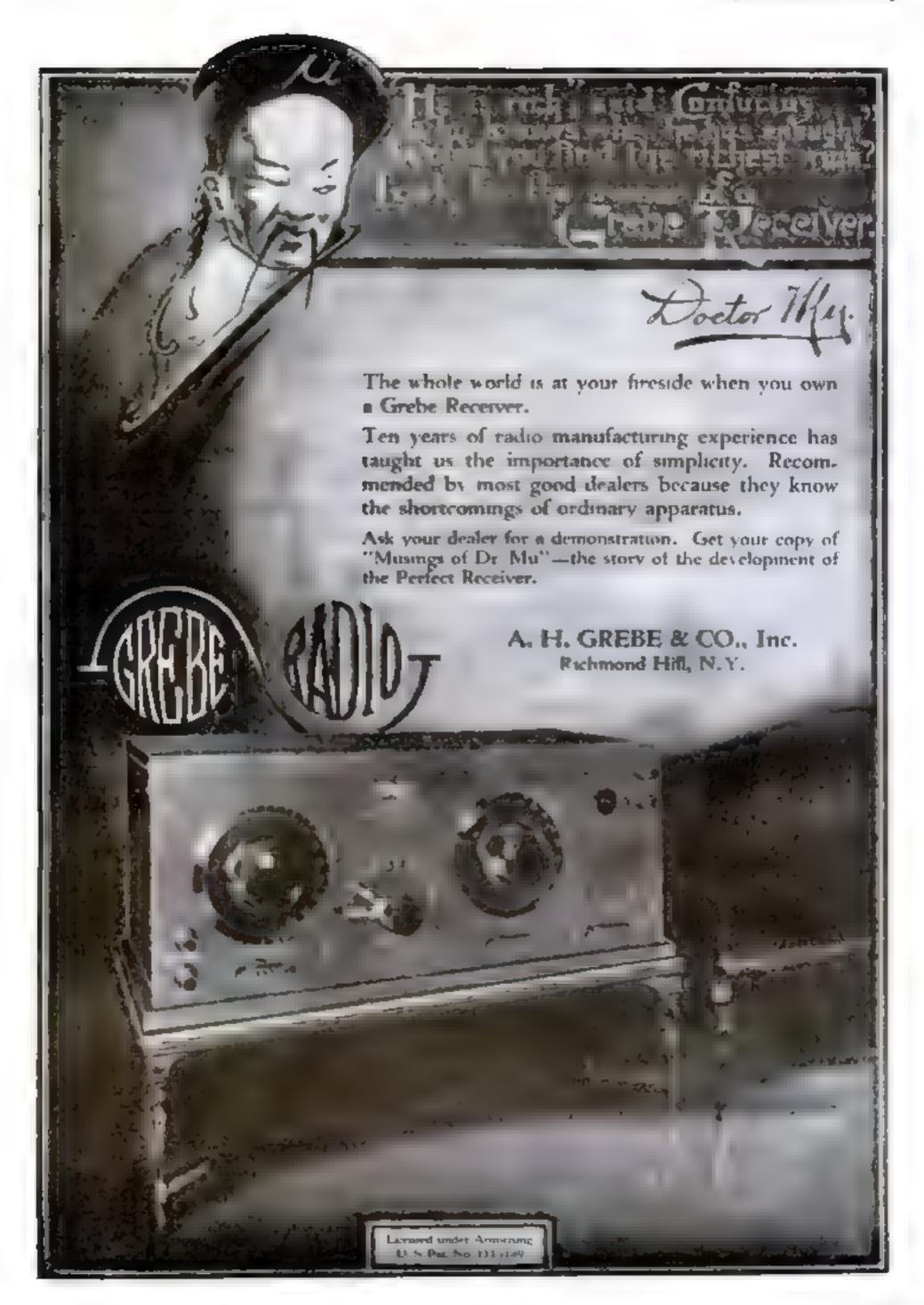
is one of five far-fluing outpusts of the Southern California Edison Company in the construction of a great hydroelectric project, in which an entire river being moved from its course and poured through a three-mile tunnel.

And the execution of this engineering achievement, described and illustrated on page 28 of this issue, is made posaible in a large measure by radio, which has provided unfailing communication not only in transmission of orders from headquarters to isolated outposts, but in bringing the cheer of the outside world to a thousand anowbound workmen

Here we have not only the first large scale application of radio to a vast engineering undertaking, but also the reassation of one of the visious of radio as a worldwide memenger-visions with which Popular SCIENCE MONTHLY started readers' interest at the very start of the radio boom, a year

MONTHLY the broadcasting of special helilay enterta prient to the arewook d conprescion crows in the Spersas was curred of by the Southern California Educat with London arrangements with London Angelog broadcast ng gtatt me







POPULAR SCIENCE MONTHLY

JANUARY, 1923



Photo Conting New York Southplate Park

"Go North, Young Man!"

Rich Opportunities Awaiting Arctic Settlers across the "Last Frontier"

By Vilhjalmur Stefansson

Famous Arctic Explorer and Scientist (As interviewed by A. A. Coates,

THE man who wrote, "Westward the course of empire takes its way," had in mind the progress of civilization for the past few hundred years only. If he had surveyed the trail of mankind from earliest history, he might have written as truly: "Northward the course of empire." For, as far back as the reliable tradition of man runs, we see the centers of power and prosperity moving steadily from south to north.

Fifty centuries ago corner lots in Egypt were at a premium. Land in Babylon at that time was cheap. Ten centuries later Banyion was the hub of the world. The great center of life and power had moved north From Bubylon it moved farther northward (and westward to Phoenicia, then northward again to Greece, and northward stall farther to Rome. With the fall of the Roman Empire and the coming of the Middle Ages, Florence and Venice flourished. Then France, under the Louis, held the reins of power, only to lose it again to Britain just before the United States brcame an independent nation

And now the admitted leadership of the world lies in the hands of the English. speaking peoples. Where will it go nex-I think there is little dealt that it will comtinue its course in the same general dimtion as it has the past 50 centuries, be-

t in last remaining frontier in the worl Yet our modern elvisization, accept by fame tiens of the upknown, just as each purcessive els figat on has done before, has



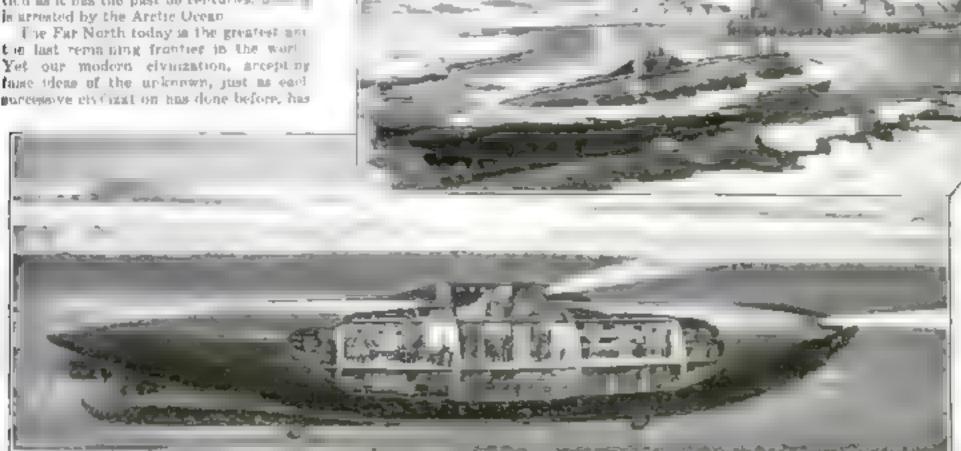
Vilhjalmur Stefansson

Explorer and accentust, who sees in the last frontier" of the North a future world center of civilization and wealth.

held back from the North in the behef that it is a dready, uninhabitable waste.

We who have lived in the region of the Aretic Circle know it is nothing like the leywante pictured by popular belief. We have ecen the greeny prairies in the shadows of The Ovibos, or "sheep gow," of the Arctic regions, which Stefansson predicts will play an increasingly important part in supplying the world with most and wool. The bull Ovibos usually weighs more than 700 pounds. The meet of these animals a much like beef, while experiments show that their heavy wool can be manufactured into available up. The Ovibos, or "sheep cow," of the manufactured into excellent un-

huge glaciers at Elleamere Island, north of Radin Ray-the northernmost land in the world. In summer we have found the gentle slopes golden with flowers, green with grant and swarming with bees and butterflies. We have counted more than



How Stefansson pictures future transportation across the polar seas by submarine ferryboats which will speed below miles of ice crust, rising to the surface in free water at port. "Submarine ferries are practical for year around com-

munication between ports that are insbound in winter, says Simon Lake, famous inventor of submarines. years I have advocated this method of winter navigation in the Great Lakes, the Beltic, and far northern sate."



A Trail Blazer of the Arctic Frontier

To VILHJALMUR STRFANSSON, venturing across the polar pack, living "off the country" for months, and penetrating to arctic lands where white men were unknown belongs much of the credit for opening the eyes of the world to the potential wealth of the Far Northern Empire. The vast expanse of this "last frontier," with its untouched hourds, and its wealth of broad grassy prairies, is shown on the map above, on which are indicated also the present railway routes by which adventurous settlers may travel to this land of opportunity

The dark strip running across the center of the map represents the northern tree line of the American continent, close to the Arctic Circle, while the gray portion of the map above this line includes the wide areas of mainland and the numerous islands which, Stefansson tells us, contain a wealth of pinerals, also sweeping prairies, ideal for reindeer and Ovibos

Stretching northward to the shadows of the polar glacters, all of this gray territory, revealed to the world largely through Stefansion's explorations, is open to profit able settlement. Indeed Stefansion himself and associates control an immense tract of grazing land in the southern half of Baffin Island, where they have estabished the nucleus of a great reindeer berd

The photograph at the right shows Stefansson, the pioneer arctic settler. Born of a family of pioneers who were among the reviest of farmer colonists in Mani

toba, Stefanmon as a boy dreamed of becoming a Robinson Crusoe --- an ambition which be was to realize later. Attending the University of North Dakots and the State University of Iowa, he turned to scientific study of the history and life of mankind becoming an unsutant instructor in anthro pology at Harvard University to 1904. In that year be made his first expedition to Ice

Stefansson's most brilliant and adventurous journcy was undertaken in 1914 when, ps

commander of the Canadian Arctic Expedition, he and two companions made a 600-mile sted journey over broken and moving ice from Martin Point, Alaska, to the northwest of Banks Island. This during expedition was followed by the discovery of a new land north of Prince Patrick Island and of new islands far above the Arctic Circle. On the map are indicated three discoveries credited to Stefansson—Meighen Island, Border Island, and Lough and Island. These explorations contributed much to exigntific knowledge.

700 species of flowering plants porth of the Arctic Circle. We have watched great herds of reindeer and Ovibos, or "sheep cows," as they grazed over fertile practice—promising a bountiful supply of meat for years to come

We have seen the rich natural resources of this untouched empire, and we know now that since it has all been explored and mapped, the age of colonization is at hand, bringing with it the hope of relief from the congestion which is a growing menace to our civilization.

Naturally there are difficulties to settlement, as in all pioneering, yet the northland in fairly accessible. You can buy tickets, if not in New York, certainly in Winnipeg, to take you by railway and hoat (on the Marketsie River) clear to the Arctic.

Ocean. The railway runs now to McMurray, Alberta, where it connects with the boat line on the Mackenzie, and, barring portages at rapide in a few places, the trip is then made on tirely by water, cheaply and easily.

Not for Sightseers

The Mackensie is open to navigation during the polar summer and offers a direct route to Point Barrow the tiptop of Alaska. However, I should not recommend the trip for aghtaeeing alone. To the traveler the voyage is not especially picturesque—just about like traveling up the Missouri River, with little scenery except high banks, generally forest clad.

The journey overland is not so simple. It is about like crossing Nebraska before roads were built. In the summer the ground is soggy and soft, so that wheels are nearly useless. Here, in time to come, the endless tread tractor will be extremely useful in certain parts of Alaska already.

they are being used to haul lumber, and they can be operated successfully in almost any pour region. We have done most of our overland traveling in the winter, for even where there is little show, the sieds all pover the frozen ground; and when you come to a frozen lake, crossing it

we hunt as we go, and therefore we need carry few provisions
Caribou are found all the way from the
fringes of civilization on the south to
such northern lands as Melville Island and
Horden Island. Then there are Ovibou,
the northernmost land spimals in the
world -a sort of cross between cow and
sheep. They may be found clear to the
north tip of Greenland, and hunting them
to about as easy as hunting a herd of cattle
in a meadow

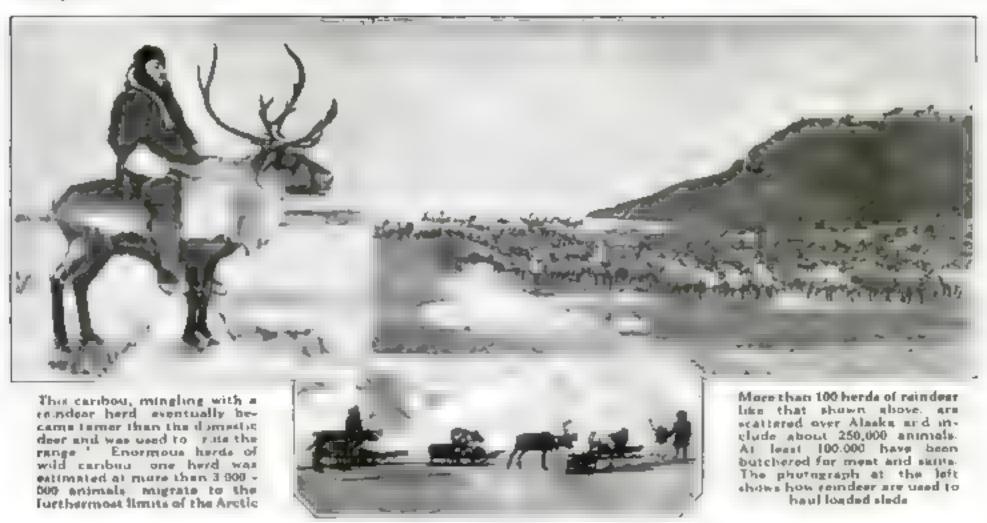
becomes a real pleasure—like snow-

Railways Needed for Settlement

When rallways are built into the Far North settlement will be simpler. Keeping railroads open during the long winter months will not be as difficult as it is in the American and Canadian Northwest today, for there is much less anow as you go north from the international border and east from Alaska. You have more anowfall during



Eskimos at Nome drawing reindest for United States markets. The North, Stefansson says, is destined to be the world's mest rawing center



the average winter in St. Louis or Richmend. Va., then we do on the northern tip of Alaska.

The growth of air transit -commercial

FRANCE, 609 ROME, MO

The steady advance of empire

northward into cooler, mure in-

vigorating etc. a march which,

according to Stefansson, has coincided with that of civiliza-

tion -- is illustrated here. Aver-

age annual temperatures of succeeding world capitals are

by a system of submarine ferrice, giving transportation as adequate as the surface ferry system now in use across the English Channel.

By far the greatest difficulty in colonizing the North will be the necessity for colonists to change their viewpoints and their habits in many respects. We are, most of us, an agricultural people, and we have grown accustomed to raise certain crops in certain localities. Par that reason when we move to a new place, especially a place where climatic conditions are radically different from those to which we are accus-

> tomed, we are inclined to be disguated with the new place because there we cannot grow what we grew at home. When the first settlers

> > GREECE, 619

Himois is good for quite a few things, even if it has no balmy Januarys and will never be worth anything as a cotton field or sugar cane plantation

Settlers must learn, as I had to, first of all. to utilize pature as they find ber, and not try to bend her to their uses. They must discover first what the land will produce and then set about producing it. Now, the polar region will not grow cotton or wheat or tomatoes, hut it will grow most garden vegetables, and, most important of all, ment.

The North Has Its Strawberries

When I made my first journey down the Mackenzie River in 1906, I saw strawberries successfully cultivated in gardens of the Musica at Fort Providence, 500 miles north of Edmonton, Alberta. At Fort Good Hope we bought potatoes that had been raised practically in the Arctic Circle, and I have talked with traders who

raised carrots and cabbages in the Mackensio delta, fully 100 miles north of the Arctic Circle. Yet, while it is true that most of the common gurden vegetables can be grown in about (Contenued on page 100

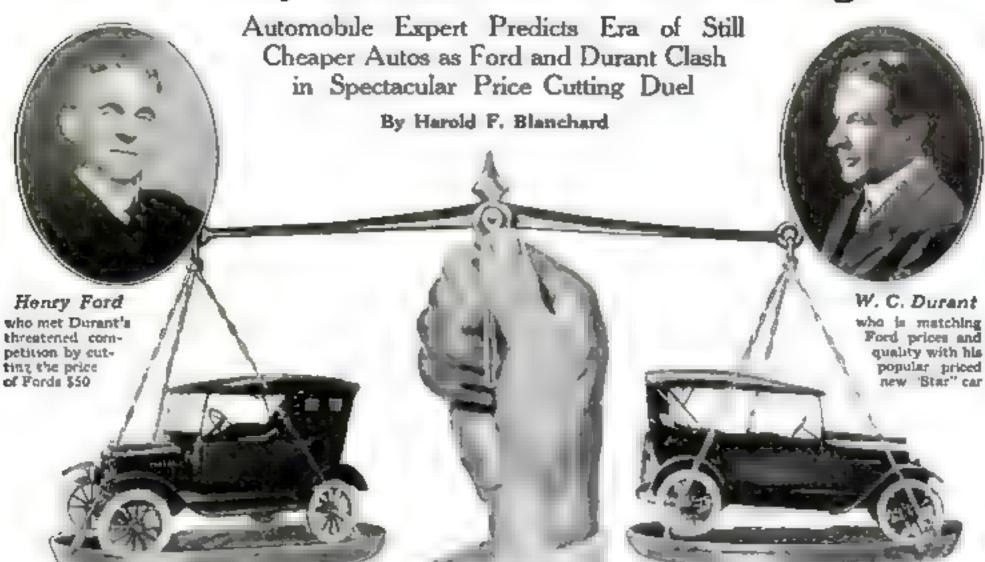
and pussenger service will aimplify the problems of the north tremendously. Much of the polar basin lies in direct lines of transit between great centers of power and population, such as London and Tokio. With air transportation, islands in the polar archipelago such in Banks, Melville, Victoria, North Devon, and Prince Patrick, which are dangerous for steamships to approach, because of floating tee

in the sea, would be put into direct communication with the rest of the world.

Freight and Passenger Submarines

Submarines, too, promise a successful means of quick transportation; for submerged power boats would be able to cruise along under the floating crusts of ice, rising to the surface in clear water in port. In the light of recent experiments along this line, it is not too much to expect that some day the greater northern islands will be served came up from Louisinon to settle southern Illinois, they found they could not rame sugar and cotton there, so they went back home after a year and said the new land was a howling wilderness and incapable of supporting human life. Yet we know now that

Is the Day of the \$150 Car in Sight?



E ARE facing revolutionary developments in automobile manufacturing and automobile price cutting, such as we have never known before! At least two distinct groups of automobile manufacturers are girding themselves for the battle, and there are rumore

Almost balancing each other on the erales of price and quality, the familier Ford and Durant's new "Ster" (at right) are matched in a race for popular

that a third may enter the field. Already W C Durant, the man whose business graus made possible General Motors, Chevrolet, and the Durant Company, has thrown down the gauntlet, and Henry Ford, until now supreme in bis field, has taken it up

The public stands to win no matter who else wins or loses—and the question of the hour is: "How low will gulomobile prices go?"

Personally, I besteve the \$160 car is a possibility. I believe that the present state of industry makes it possible. There is an air of impending drama right now about the whole automobile industry. A year ago, some automobile manufacturers who were not so far-sering as others, were worry og about what they called "saturation." They feared that the production and sale of automobiles had reached their highest points. Today they realize that their fears were groundless—that there is no such thing as the

saturation point so far as the sale of autos is concerned provided the lowering of prices keeps pace with increased production

There is little doubt that the production of automobiles in 1922 exceeded all records. In 1920, 2,276,000 cars and trucks

were produced. And in 1921, although numerous contributing factors made it seem impossible to reach that figure, the record was excelled

Up to October, 1922, 1,873,000 cars were produced. The month of October added another 244,000—44,000 ahead of the best

veloped with only a passing stir of public interest. Here is a really dramatic avent and it is almost unnoticed. Never before has an automobile manufacturer challenged Ford in his own field. But now comes Durant and meets Ford quality and price. And so alert has Ford been to this—his first real

fever—a race which Harold F Blanchard says may result in a price-cutting duel and still cheaper care for everybody

> competition— that he startled the country this fall with his famous \$50 price cut, making Fords cheaper than many phonographs and radio sets.

More than a year ago there were rumors about Durant's new "Star" car, These were followed by Durant's spectacular sales campaign. There was some speculative tack about a Ford-Durant war, but both men were ment on the question. Then came further operalation as to who, besides an indefinite, vague "Wall Street," was back of Durant and his projects. Most people failed to take him erricully—most people except Henry Ford. And in the meantime, Durant Motors, Inc., has placed on its books orders for 300,000 more cars than it can produce in the next 14 months despite its scheduled annual production of 231,000 cars.

W C Durant's career from its beginning to the present time has been spectacular. A grandson of Governor

Crape, of Michigan, he worked his way up in the lumber mills where he was first employed, learning the lumber business from beginning to end. At the age of 21 he had earned for himself a place as one of the executives of the mill by his remarkable.

Better Highways Mean Cheaper Cars

By William C. Durant, President of Durant Motors

THE motor cur business is still in its infancy. Development of the automobile is only in the experimental stage. The next 20 years should witness an expansion of automobile manufacturing more marvelous than that of the two decades through which we have just passed. Automobile development should parallel that of the development of our rankoads.

Not so long ago, restroads were at the stage where they built around obstructions instead of eliminating them. Then they succeeded in making their rail lines straight and comparatively free from steep grades, thereby paving the way for rapid transportation and the enormous development of railroad traffic.

The same thing is happening now to automobile highways. Our motor car of today is built to withstand hard usage because our highways make this necessary. Most of us will live to see the country covered with a network of comparatively level highways. And, when we do, radical changes in construction of the automobile will be possible. Less powerful, and therefore lighter engines will suffice. And with lighter engines the outire automobile construction will be lighter and cost far ics.

Many of the structural changes will be radical and a large perrentage of the present weight of a motor car may in this way be eliminated. Every highway that is built creates a new market for the automobile and we have just started to build roads.

previous October record. On top of this, there is the prospective duel between Ford and Durant and the possibility of a third great price cutter entering the field, with consequent increase in demand for automobiles.

So far, the Ford-Durant war has de-

of those who see the pos-

sibility of automobiles be-

coming as common as

watches and as cheap in

comparison with present-

day automobile prices as

dellar watches now are in

comparison with the prices of watches of other days.

cheaper car than we now believe possible is only a

question of the develop-

ment of highways," says

this genius of the auto-

more automobiles would be in use in America today

if the condition of our

highways permitted. When

our automobiles can be

built to run on highways

that are on the average as

good as our city streets-

and this is bound to come sooner or later-we shall

have lighter, better, and

far cheaper cars. And that time is not far distant "

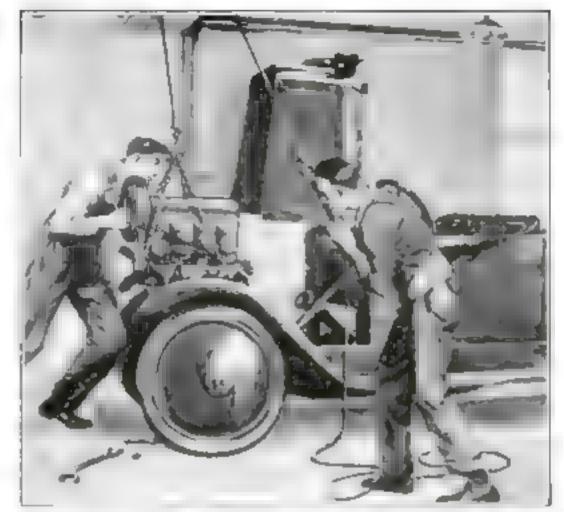
Speculation as to wheth-

"Milliona

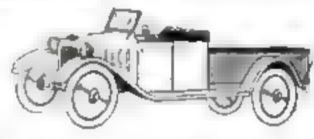
mobile world.

"The development of a

ability to grasp fundamentals of business. Turning to other fields, he rescued a cigar concern from financia, death by Injecting efficiency and enthusiaum into the business. Then, seeking a larger opportunity for himself, he assumed the management of a demoralized waterworks company placing it upon a sound financial basis. Now began bie real career as a vehicle manufacturer. Seizing an opportunity to become a partner in a company manufacturing two-wheeled carts, he soon developed the company to a point where it was turning out carts at the rate of 100,000 a year. But that success did not satisfy him, for he had visions of the tremendous possibilities of the haby automobile in-And so, with dustry. \$15,000 capital and a new



The Bustration above shows possible cost saving features of the \$250 car, as predicted by Harold F. Blanchard engine, storage battery and generator in one unit that can be lifted out easily for repair; hood and dumnsy radiator in another unit that swings back to permit access to engine. The accompanying drawings show roadster,



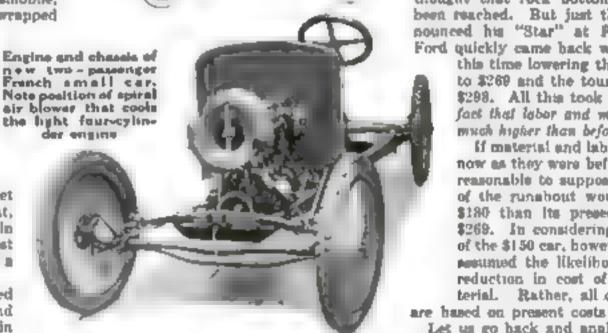
automobile engine lavented by a farmer whose game was Buick, he began to manufacture automobiles at Jackson, Mich.

It wasn't long until the name of Buick was known the world over. The next step was the purchase of Cad line, Oldsmobile,

and Oakland plants. Durant wrapped these plants up in one package and called it "General Motors." Because he needed money to finance this venture, he turned to Wall Street, where astute financiers gave him the money, but acquired control of the company. Then Durant worked out a plan to regain control of the company for himself-s pien

that worked so well that Wall Street was astounded. More than that, Wall Street kicked itself when in 1915, with Durant in control of most of the stock, General Motors paid a dividend of \$50 m share!

Meanwhile, he had consolidated Chevrolet with General Motors and had built up that concern until in touring car, and truck models



This new English four-passenger light car, only 5 feet 5 inches long, and weighing 550 pounds, has all the up-to-date equipment of a full-sized touring car

1920 it bounted of 23,000 employees, 12,000 dealand over 60 000 stockholders. At that pinnacie of success be broke away from the corporation, resigning the presidency of General Motors to organize Durant Motors, Inc. During the first nine months of his new yenture he booked \$31 000. 000 worth of business and sold 30,000 automobiles. What new spectacular feat he will accomplish in the future remains to be seen. But certain it is that he is one

er these cheaper automobiles will fall as low as \$150 is timely in view of Henry Ford's recent cut in his prices. When Ford dropped the price of his roadster to \$319, and the touring car to \$348, most people thought that rock bottom in prices had been reached. But just then Durant ansounced his "Star" at Ford prices and Ford quickly came back with his \$50 cut,

this time lowering the roadster price to \$269 and the touring car price to \$298. All this took place despite the fact that labor and material were still much higher than before the war.

if material and labor were as cheap now as they were before the war, it is reasonable to suppose that the price of the runabout would be closer to \$180 than its present minimum of \$269. In considering the possibility of the \$150 car, however, we have not sesumed the likelihood of any such reduction in cost of labor and material. Rather, all our assumptions

Let us go back and analyse events that have led to the \$269 price for Fords. Fourteen years ago, when the present Ford "Model T" was unnounced, it sold for shout \$1000. It now sells for \$398, and

far excels the 1909 model

Why Prices Have Dropped

The difference is due to two factors -increased production and vastly more efficient manufacturing methods. In 1909 the production was 18,000 cars—a figure that was considered tremendous at that time. Now the Ford factory turns out that number in less than three days-the average daily production is about 5000 cars—while a yearly production of 1,500,000 is a conservative expectation

Such a record has been made possible by extraordinary improvements in machine

(Continued on page 90)

How Engineers Moved a River through a Mountain

patural a tree from a flow many is a tree from the flow many grant a transport of the Southern Ca for a raison Company have successfully averted a serious power a sortage that threatened to don't hights in a malion homes in an about Fresno. Calif

A Race with Time

This inparatitude orgineering leaf, part of a gigantic hydroelectriproject, was accomplished by the nearly through three miles of solid grands of one of the Sierra Madromounts as, about 40 m les north. Freezo, and leading the waters of the San Joaquin River to a tour where a sheer drop of 680 feet can be eather that he cataline for the manufacture. A water that her for the manufacture is a water that her drop of 680 feet could be where a head of 1500 feet could be obtained, but time did not permit the. Each day the shortage of



While the work of tunneling was in progress, another gang was busy constructing the power house and perstock—a task that was compacted just as the tunneling cress reached the end of the three-mile lare. The perstock of welded steel jupe, eight feet in diameter, had been led 2700 feet up the side of the mounts in to the place where the tunnel was to break through

Changing the River's Course

When all was in renderess, the last wall remaining in the tunnel was blasted away, and with a great rush the waters of the San Joaquin River left its bed and pushing through the man made tunnel, washed the loose boulders out of the aqueduct. In an acree, by short time a complete power plant had been built where nature had never intended there should be one. Before power consumption at Frence had reached the limit of production, a new set of turbines was humaning.



The nerve center of operations. From this radio room at the Cascada handquarters camp in the high Sierras, engineers of the Southern California Edison Company direct the work of 1000 man engaged in the San Josquin River hydroelectric power development



The blast that diverted the San Josquin from its natural channel into a three-mile tunnel under the mountains and thence to the penstocks of the power plant. The upper photograph shows drilling operations to test the river floor

power and light was becoming more critical. It was a case of rush work or a city thrown in darkness. Therefore it was decided to utume only a portion of the available power by immediate construction of a power plant.

Radio Proces Its Value

Tolling night and day, in three shifts of eight hours each, the workmen attacked the mountain from both ends of the prospective tunnal. In spite of delays caused by the coming of winter, with heavy snows in the mountains, the end of 180 working days saw the long tunnel ready for its first washing.

How the use of radio, providing a means of unbroken communication between engineers in the headquarters supply camp at Cascada and crews of 1000 workmen snowed up in distant outpost camps, aided in this extraordinary race against time, is told on page 21 of this issue.

Wanted-Radio Legislation!

IF RADIO isn't all it should be today, the fault lies partly with each one of us. National legislation is vitally needed. But Congress won t pass legislation on behalf of radio unless or demand it. Given legislative encouragement with some legal leeway in wave lengths, and the broadcasting stations would be fully capable of making radio programs so popular and universal that there would be 15 000 000 receiving sets in use in this country, material of the estimated 3.500,000.

Ever most last June, the White radio bill has lain neglected in Congress. Radio experts all agree that once the bill goes before Congress for discussion, beneficial legislation will surely result

All our rosy hopes for the future of radso, following Secretary Hoover's famous radso conference in Washington, have been doused in the cold water of legislative neglect. The interests of millions of present and prospective radio fame demand that Congress speedily take up this matter of radio legislation.

And Congress will act if the public instate. Every reader of this page shares the responsibility for determining whether radio shall continue to languah as it does at present or to thrive as it might. Write to your congressman, sak that prompt consideration be given to the White radio communication bill. Dots that this abda any longer. Play your part in the encouragement of radio. Write for action. Do it NOW

Thus passed the crists in the impending power shortage, marking the crowning effort of a courageous band of men who labored uncessingly for six months at an elevation of sometimes 10,000 feet, cut off by impenetrable snow-drifts from the nutside world with which they communicated by radio and dog team.

Huge Power Development

This particular plent is but one of a series of power stations that will make the San Joaquin hydroelectric development one of the world's greatest power producers. A total of eight separate plants will harness waters of the river, utilizing the power produced by gravity in the drop from an elevation of 9000 feet at the source. The system will produce 929,000 kilowatta of electricity, or 1,290,-000 horsepower—an output that will be about 70 per cent greater than that of the famous Niegara Falls development.

Great 350-Foot Steel Bridge Sheathed

with Cement Shot from Guns

Wire Mesh, Welded on Steel, Holds Protective Coating

ARMED with cement guns engineers are now completing the stupendous task of "shooting" 60,000 square feet of exposed steel structure with fine grained liquid concrete, conting the 350-foot bridge over the Willamette River, near Oregon C"ty, Ore,, with a protective sheath

of cement 116 inches thick

Faced with the necessity of giving the new bridge a covering of concrete and unable to pour the materials in the customary mannor because the extreme depth of the river made scaffolding imposarble, the engineers determined to overcome the problem by the use of the concrete gun. The protective conting was made necessary by the fact that the Willamette bridge is in the vicinity of several great pulp mills, which liberate sulphurous unhydrid gas. In the presence of moisture, this gas combines with water to form a solution of sulphurie acid that would tend to corrode the eteel supidly.

How Mesh Is Attached

The arch of the bridge rises 100 feet from mean low water. Each steel rib is 2 ly feet thick and from six to 10 feet wide. Lines of heavy wire were first crimerossed and welded directly to the ribe, a task that required nearly 50,000 spot welds. Then substantial mesh was wired to this pattern of heavy wire, completely covering the structural steel and forming the support for the plastic cement.

The webbing was welded on rivet beads so that it would stand away from the steel, allowing cement to get behind it and bind the whole together securely. The finished work is practically a perfect smallgamation

of steel and concrete

The operation of shooting the concrete or "gunite" requires skilful work. Coment and dry, acreened eard are first mixed with water and fed into the hopper of the gun. The gun receives a pressure of from 60 to 80 pounds from an air compressor and shoots the mixture through a 1½-inch hose. A skilled operator continually apportions the intake and inspects the line for clogging. Since the mixture must sometimes be shot through hundreds of feet of rubber tubing in order to reach the farthest point

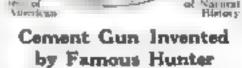
of the arch, the pressure must be very high.

The steel floor beams and stringers are covered with poured concrete. As a whole the bridge represents the greatest piece of gunite work ever attempted, and if it proves completely successful, will probably stand as a model for future structures of the kind.



Wearing masks to pretect their eyes and faces, spot welders fasten quarter-inch wire rods to the steel, as shown above. The entire job required 50,000 electric spot welds

DID you know that we are in the midst of the greatest era of bridge building in the world's history? In a following murellous prosecity bridge system for rapid transit recently proposed



PHE modern cement gun, of the kind used in surfacing the steel ribs of the Willamette River bridge, as described in the accompanying article, had its origin, strangely enough, in the mounting of wild animals. It was invented by Carl Ethan Akeley (above), famous wild animal bunter and now taxidermint in chief of the American Museum of Natural History, who devised it for the purpose of shooting concrete on to frames he had built for mounting animal skins.

Later, Akeley perfected a larger gun. Its many uses today include the covering of underground mine presents, preventing ground swelling to mines, building walls and fences, covering metal laths and furniture frames, and az tinguishing dump fires.

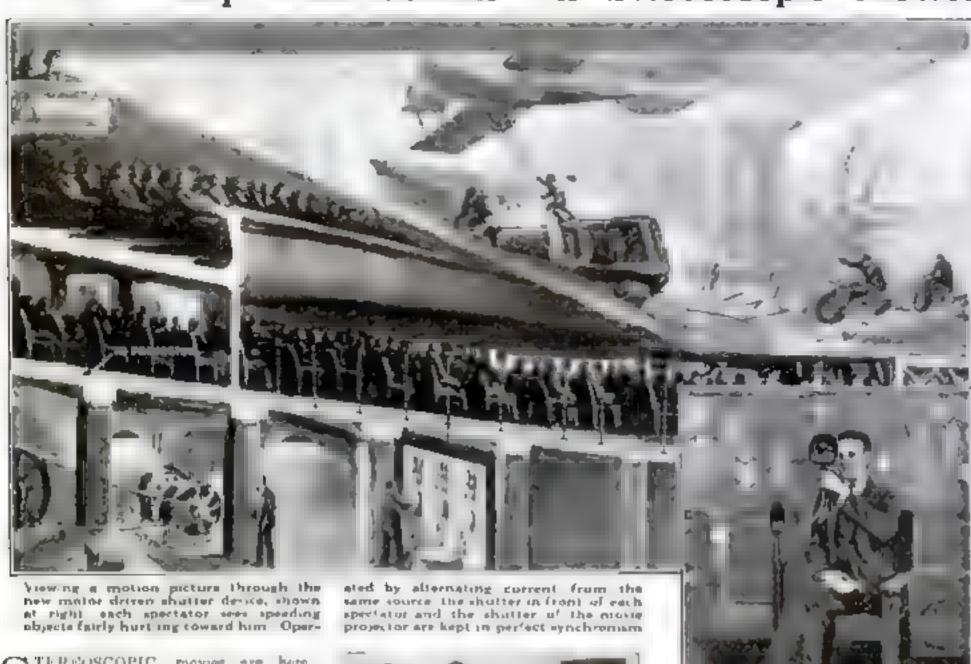


"Shooting" liquid cament against the meshcovered steel rib from the nextle of a cament gur.



The 350-foot concrete-coated bridge across the Willemette River, near Oregon City. Ore., as it will appear when completely sheethed in concrete. From the architect's drawing

Thrills "Leap from Screen" in Stereoscopic Movies



STEREOSCOPIC movies are here.

And with their contain you may experience the thull of seeing an automobile fairly leap out of the screen.

No less a personage than David Wark tord fith the great movie producer — declares that perfection of the last will do more for moving the say previous development of the that they would drive started spectations from their greats,

and you will have an open if went the stereoscopic movie will be like."

Such effects have actually been achieved by a young engineer, I altern Hammond, of New York who has neer showing his to a strong-series. The most extraors are effects of attack and are effects of attack for a result of a stack and are a result of a stack and a result of a stack and a stack a stack are a stack as a stack and a stack a stack are a stack as a stac

Horaco a reposed to the second

This stereoscopic movie camera resion 5

armultaneously exposes left and right

films which are colored sed and green respectively. Viewed through spectacles

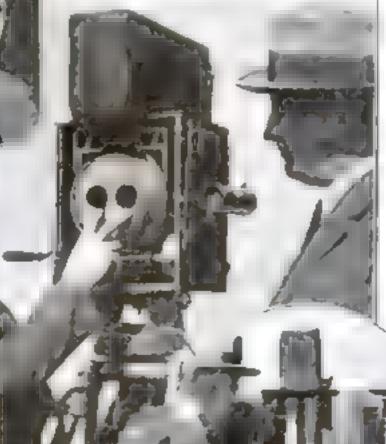
tary colors, the pictures appear plastic

demonstrated in Los Angeles

the distance between the average pair of eyes. These films are then printed alternately on the same reel, all the "even"



The left eye blinded one sees the "right" picture. Next makent the process is reversed.



By the matter dissensition and charter desire couples may a posttive and five dest at that the operator were first time right operator with the right over their the files presides with the desired at left. Once properly as parted the desired remains in the east of agestication of the puls back a same

prise is regressions from the ord? purfaces are from the "right eye" flow.

type through ar attention of the extension of the street, the shutter blands the spectator's left eye, and vice versa. The star of the street of the extension of the extension

tator. Synchronization of the state. Synchronization of the state of t

cost of equipping a motion picture theater is about five collars a seat

A Modern Chemist's Magic

How a Hobby-Loving Scientist Succeeded, Where Nature Failed, in Creating a Substance Needed by Man and Now Used in Hundreds of Ways in Home and Shop

By Boyden Sparkes

TIRELESS apparatus — airplane propellers pipe stems-transparent fountsin pens-phonograph records—casings for dynamos—telephone receivers-railroad signass-granding wheels buttand balls-buttons-even the golfer's

Can you imagine a single man-made material, unlike anything else on earth, from which all these articles and hundreds more are being manufactured today?

Not

Well, because Dr. Leo Hendrik Backeland-famous chemut and inventor-could and did imagine just such a material, his story has become a classic of great achievement in modern science

A "Hopeless" Problem Solved

I have just talked with this creator of the remarkable aubstance known as hakelite. now used as the essential toughening ingredient in hundreds of products familiar in every home and office. And I have learned something of the inspiring methods by which this determined scientist, tackling a most baffing mystery of nature, combined two strong-smelling liquid chemicals as if by magic, to form a solid product tougher than amber, resistant to beat, moisture and electricity, and ideal as an insulator.

Sumetimes the dreams and labor of many men, throughout years of research, go into the perfection of a single invention More often, a lucky accident is the source of a new scientific principle or device. But occasionally, a single miracle worker accomplanes in a few months of intense welldirected effort, the solution of a "hopesea" problem in invention.

Such a modern miracle worker of sesence is Doctor Backeland, formerly professor in a Belgian college, now honorary professor of chemical engineering at Columbia University.

Working with Intense concentration toward the solution of problems that had

buffled all other experimenters, be created something that never existed before. And when his self allotted job

Who Will Free Hoarded Energy of Light?

EASCINATING possibilities of future wealth -visions of new wonders of creative accence -open up as we listen to the words of Dr. Leo. H. Beekeland, the chemist whose two greatest creations vrios and battelite -- are known to millions of Americans.

"The forces of nature," Doctor Backeland says, "are the most enduring wealth of mankind. Because science has taught buts nature's laws and how to apply them, a puny little being of from about 130 to 200 pounds of flesh and bone three fourths of which is water has become a giant un-

equalled in Gulliver's travels.

And what are the still undiscovered tecrets among the powers of nature? Doctor 'Our annual crop Backcland answers of plants containing starch or sugar could supply us with an abundance of liquid fuel. We may look at this possible new source of power as simply the stored up energy of the sun. The chemical action of the sun a rays that we call photochemical action, under the influence of the green matter in plant leaves, brisigs about the most subtle chemical changes.

"Without this plant reaction under the influence of light there would be no crops, and upon it the whole living world de pends. Our vast così beds, our petroleum wells and our natural gas are merely light energy stored in plant or animal life of former geological periods and preserved to us. This in steelf ought to impress us with



Dr. Leo H. Backeland

the enormous possibilities of photochemical synthesis, or the forming of complex substances by the combination of empler substances under the influences of light AND YET KERS IS A FIELD WHERE THE SCIENTIST AND ENGINEER HAVE ACCOMPLISHED NEXT TO NOTHING. In the utilization of this marvelous energy we have not gone much beyond the art of making photographs.

Neglected by Scientists

So here is a power, an energy, which has been neglected by scientist and engancer alaka. Who will show us bow to uso it? Who will teach us how to emulate nature is her creative use of the sun's rays? Who will discover how to utilize this delicate method of securing new riches and power for municind?"

What a vast opportunity is open here for the persevering scientist or inventor!

was finished, he promptly put it out of his mind, leaving its commercial exploitation to others, and turning to play and bobbses with the same intense interest he gave his inventive effort

We must turn to one of nature's great dramse to find a parallel to Doctor Backeand's achievement. Whirling through space, our earth is continually encountering bits of cosmic rubbish which at pight are revealed to us as meteorites. Of the meteorites that reach the earth, many are found to be composed of an alloy of Iron and nickel. Some have contained other substances with which we are familiar, but in others have been found substances that never before have been encountered on

Varied Every-Day Uses of Bakelite

earth, and that have been given such names se maskelynite, trouilite, and oldhamite,

Bakelite, conceived in the mind of Doctor Backeland, may be likened to these substances. Nature had not given us its like on earth, when Doctor Backeland set to work to create it. It is an artificial resinthat can neither be melted nor dissolved, that possesses great mechanical strength, and is resistant to moisture, electricity, and steam, as well as to most acids and chemicals. These properties have made bake-

lite, and other widely used products like it, the premier insulation for wareless com-



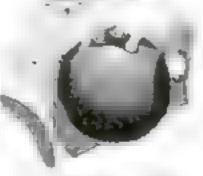
Armatures for electric mutora





Transparent, amberlike pipe steams

Durable radio instrumoons to



Tough, unwarpable bowling balls



Radiator caps for auto-



Telephone transmitters and receivers.



munication. To millions of users of radio receiving acts, these products are now familiar, and hence the story of the original invention has assumed increased popular interest

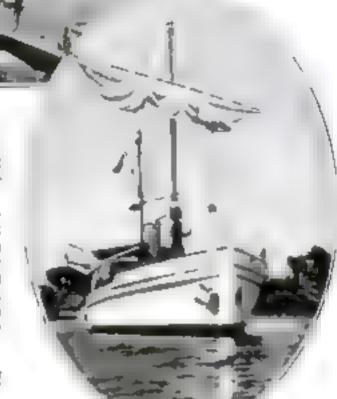
"My friends have asked me how I happened to strike such an interesting subject as this synthetic resin to work upon," eays Doctor Backeland, "and I can answer that I did not strike it in any hapbazard way. I looked for just such a subject for a number of years, until I found it among the many lines of research I undertook in my laboratory"

Achievement, Not Wealth, His Object

While working on his problem, Doctor Backeland rarely spent an entire night in bed. Often he rose at two or four in the morning to make notes—a habit of his. And it was for sheer achievement, rather than for wealth, that he worked in this way "One of the saddest things in that money should ever be regarded as the measure of success," he says. "I could have made twenty or thirty times as much money as I have, had that been my ambition. Any fool can get rich at the sacrifice of his self respect and rest. Don't select a profession just to become rich-be a bootlegger, if wealth is your alm. But whatever you do, be the thing you love to be. If we made football a compulsory part of the curriculum at Columbia, the students would sue us for crueity "

A tall, sunbrowned man with a jovial countenance lighted by hazel eyes. Doctor Backeland impresses you as a retired American business man with a few hearthful hobbies, rather than as a Belgian smentart. His talk is of yachting, of books, of politics, rather than of science. And it is in yachting—almost as much as in his beloved chamistry—that his heart lies.

"My boat," says he, "is a 24-ton brigantine-rigged, auxiliary powered yacht. She was a ladylike cruiser when I got her, but she had the splended hull of a schooner. When I put in for the night, people comment on her strange rig. The square said forward, and the fore and aft said spilling



For recreation at-

mental work in his laboratory, Doctor Badefand turns

to yechting, his favorite hobby.

His unusual craft.

rigged like a brig-

antine, with large

forward square sail

into which a fore and aft sail spills a feir wind

ahown

below, is

ter buttent experi-

the wind into it, are not often seen. Some of my friends, of course, cannot understand why I make only four or six knots, when I can make nine and a balf. But the cruising yachtaman must be an artist, a lover of nature, and an adventurer "

So much for his hobby. Now as to his life and work.

Leo Backeland was born in the Flemuch city of Ghent, where he received his early education. Later, he graduated from the University of Ghent, where eventually he became an associate professor.

Meanwhile Backcland had been awarded a chemistry prize that included a traveling scholarship, enabling him to visit univer-



THESE three photographs reveal how a bakekite distributer for the usual automobile agnition system is made in three simple steps. Above Bakelite powder is weighted in draired quantities. At left. The powdered bakelite is poured into molds and subjected to pressure of from 1200 to 2000 pounds to the square inch. At right. The completed distributer showing how the powder is transformed by heat and pressure into hard insulating material, taking impressions of the mold.

sities in England, Germany, Scotland, and finally in the United States, a country which be learned to love and to which he eventually returned.

Ghent had been the center of the new industry of dry-plate manufacturing. Backeland had interested himself in this industry and was a competent amateur photographer. So it was that within four years after his arrival in the United States in 1889, he founded a chemical company for the manufacture and development of his colloids silver chorid photographic paper—velox—which was so attractive to the Eastman Kodak Company as a commercial proposition that they bought his rights.

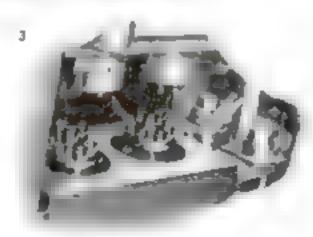
That success was but a start for Backeland. He then turned his attention to electrochemistry. Soon he was selected by Elon T. Hooker to direct the work preliminary to industrial development of the now famous Townsend cell for producing sods and chlorin from salt. This work finally led to the erection at Niegara Falls of one of the largest electrochemical plants in the world, with which Doctor Backeland is still connected in an advisory capacity.

A Search for the Answer

In his laboratory work Doctor Backeland was impressed by the abruptness with which reactions always terminated after formaldehyde and phenol (carbolic acid) were mixed. Under certain conditions the mixture produced a resin that was apparently insoluble. It occurred to him that if he could find a solvent for the worthless resin, he might produce a varnish superior to any that had been produced. This supposition proved impracticable, but led him to Bakelite.

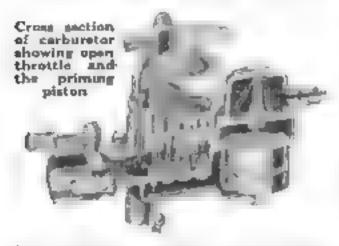
Doctor Backeland found that when equal parts of phenol and formadehyde were mixed and warmed in the presence of an alkali that combined the substances without itself being absorbed, the solution separated into two layers—the upper being a watery substance and the lower a resinous substance. The resin was soft, pliable, and soluble in alcohol. But if heated under pressure it was hard, inclusive, and insoluble. This was bakelite—the answer to the problem which had been thought hopeless.

"The two stages in the preparation of hakelita ara convenient in many ways," says Edwin E. Slosson in his book on creative chemistry. "For instance, porous wood may be souked in the soft resin and then by heat and pressure this resin is changed into the bakelite form, the wood coming out with a hard finish that may be given a lacquer polish. Paper, cardboard, cloth, wood pulp, sawdust, asbestos, and the like may be impregnated with the material, producing tough and hard substances. When forced, in powder or sheet form, into molds under pressure of from 1200 to 2000 pounds to the square inch, the regin is capable of being made into a hundred various objects."



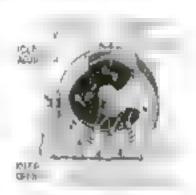
A Dozen Carburetors in One for the Auto

PERFECT vaporisation and exact proportioning of gasoline and air are claimed for a new carburetor that is equipped with from seven to 18 gasoline



jets, including an idling jet, the number depending on the size of the carburetor.

Each of the jets is located in a well, one end of which is uncovered by the movement of the rotary throttle. In the 18-jet carburstor, when the closed, only the idling jet is exposed to the suction of



How rotary throt-

the engine; but as the throttle is opened, four more jet wells are uncovered gradually and come into action

When the throttle is opened still further,



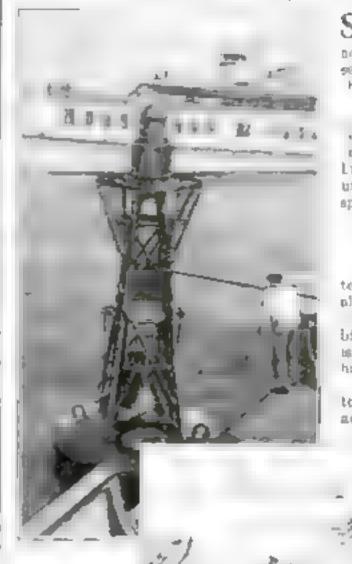
The complete carburstor, attached to car

four more are uncovered, and finally when the throttle is wide open, all 12 jets are in action in addition to the idling jet.

An auxiliary piston controiled by the throttle lever comes into ac-

tion only when the throttle is opened suddenly to its full extent and forces a preliminary stream of vapor from each jet. This aunnly of gas primes the engine and produces a quick and smooth pick-up

Saws Protect Buoys from Tug Hawsers



SAWTOOTH fine, sharp enough to part a heavy hawser, have been adopted by Uncle Sam's lighthouse service as protection for huoys from he carelessness of tugboat owners.

Often when togs with strings of own in tow attempt to turn sharp were around buoys, the towline atches on some projecting part of the luoy and puts it out of commission until the light tenders can reach the spot and repair the buoy.

Sauteeth Will Ruin Hawsers

Angle irons with sharpened sawteeth edges have now been piaced on all sides of the buoys. When a hawser

bits into the strands. If this cutting is continued for many seconds, the hawser is parted.

Once a guilty pilot has been forced to turn about and pick up a tow cast adult by a riven haweer, the lighthouse

> service believes that buoys armed with the protective fine will thereafter be given a wide berth

When a towing hawser fouls the buoy, saw teeth placed near the top of the buoy, as shown in the photograph, out the cable

Plants Serve to Locate Deposits of Ore

THAT the location of ore deposits in often indicated by the variety of plants growing on the surface above them was a recent interesting statement of E. Lidgely before the Australian Mining Institute.

A plant belonging to the poison sumach family indicates the presence of lead ore in Missouri, he said, while in certain parts of Europe the calamine violet is a sign of the existence of sinc ore in the neighborhood. A species of bindweed, in Spain, is considered a certain sign of underlying deposits of phosphate. Beech trees, Lidgely declared, often indicate that innestone heds are to be found in the neighborhood.



Thirteen-Room Doll House Is Eight Feet High

IN COLLEGE VIEW, Neb., Lee Empfield's five-year-old daughter, Virginia, plays with her dolls in a ministure twostory house, eight feet square, which her carpenter-daddy has made with all the complete detail of a "grown-up" dwelling.

It is a 13-room house, with seven rooms on the first floor, framed like any other dwelling, and clapbourded outside. Inside it in "plastered" with gray canvas over half-inch laths.

Between floors is an open winding stairway. The rooms are partitioned just as in a real house. All the windows are framed, and have glass makes.

Mr. Empfield built the house during spare hours, in about three weeks. The material cost him about \$25. A family of nine dolls now occupies the cottage.

How to Manufacture Pure Ice at Home

ARTIFICIAL ! ice may be made at home in the winter by the use of a long abest metal box now on the market, which opens at the top and in divided into several sections Water is pumped into each section and frozen. The forms are alightly tapered to facilitate removal of the frozen cakes.

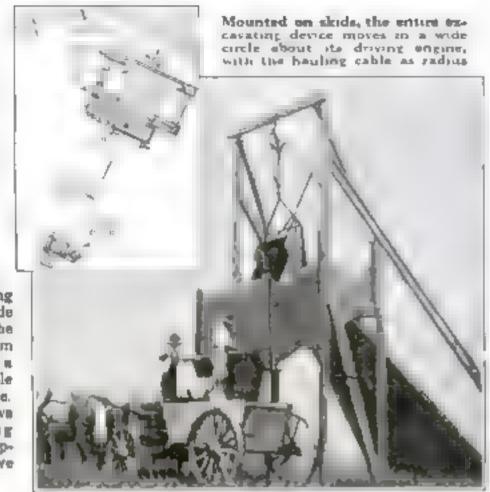


Ice cakes molded in partitioned short metal box

Excavator on Skids Travels in Circle

DIFFICULmoving excavating machinery have been reduced to a mannum by a new combination digging and dumping device that moves on akıda, describing a carele about its driving engine.

The device consists of scaffolding supporting a ramp on one side and a chute on the other A crossbeam at the top holds a pulley for the cable from the engine. This coble drawn the excavating shovel to a dumping position above the chute.





Radium Rays Put Color and Value into Gems

RADIUM rays will change yellowish dismonds of small value into emeraldtinted gems through a process, discovered by the United States Bureau of Mines, which may make the most beautiful dismonds comparatively inexpensive. The acquired luster is permanent, resisting the most powerful acids

Rays from a container of radium, directed upward, are focused at a small hole in a lead block. Over this hole the diamond to be colored rests in a vacuum upon a thin sheet of aluminum. The exposure is continued, sometimes as long as 16 months, until the color of the gem changes from yellow to green

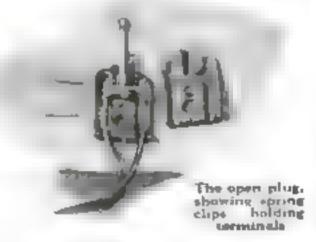
Cut supphires have been colored a bright. cansty yellow by the same method. Even coloriess rock sait can be colored a golden yellow hue, which is destroyed either by exposure to direct sunlight or heat.

A scientist of national repute is now making X-ray spectrographs of colored rock sait to determine whether any change in the position of the atoms is produced by the radiation.

Phone Plug Spring Clips Make Easy Hook-Ups

EQUIPPED with spring clips that hold the terminals of a telephone cord so firmly that perfect electrical connection in obtained without soldering, a plug recently invented comes as a boon to the wareloss operator in making experimental hook-ups.

In the spring leaves are holes into which the terminals are forced. The spring action, tending to force these holes out of line, produces a grip on the terminals.



forward into place,

it is held rigid by

collapsible braces.

New Bandsaw Has Many Uses in Pattern Shop

BANDSAW invented by W. W. A Paddock after 25 years' experience at the bench, has attachments that make it a complete tool for the pattern shop. In addition to bandsawing at many angles, the attachments provide for disk sanding, roll sanding, wood boring and turning, emery grinding, and wire or cotton buffing,

How Angles Are Obtained

The saw is motor driven. Ball bearings reduce the amount of power required to one-half horsepower. The eaw table can be tilted on either side of an are that is graduated in degrees each way from the table level. The limits are, forward, 45 degrees, right-handed, 45 degrees, and down, lafthanded, 30 degrees.

The motor belt and the saw are on the same pulley casting, the saw pulling up and the belt down, reneving the bearing of ten-

The bandsaw itself is guided between three ball-bearing wheels, one on each side of the roots of the saw teeth, and one a



The motor driven cay, with ingenious attachments for performing a variety

V-grooved wheel at the back. This forms a frictionless guide, as all wheels turn with the saw. Below the table is a V-grooved wheel similar to the upper one. A safety fiber wheel is pinced a quarter of an inch in front of the saw, preventing it from being pulled forward of the band wheels.

shield for the passengers

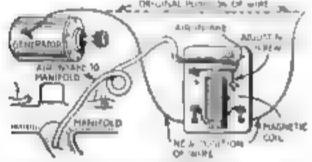
Novel Windshield for Disappearing Seat

THE problem of providing a such able windshield for disappearing sents in the rear of an automotion and ass been solved in an ingera ass ma ser by an English manufact rear Tree forward portion of the rear does contains three glass covered portholes, while the rear portion tips down to form the back of the sest. (See Electrations at right.) When the unique windshield is tipped Circular windows in the desappearing rear deck, when ressed, form a wind-



Auto Generator and Magnet Control Intake Mixture

AUTOMATIC control of the air that should be mixed with fuel to produce maximum efficiency for the automobile motor is achieved by an ingenious magnetic coil device attached to the generator of the



Magnetic coil, connected with generator and manifold, controls air supply

car, and containing an air intake that leads through a pipe to the intake munifold

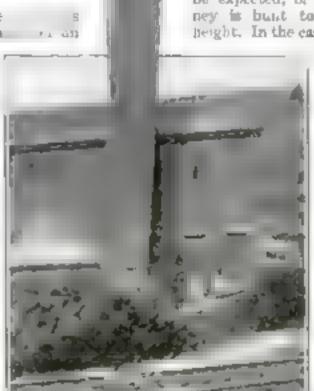
The air intake is regulated by a valve attached to the magnet armature that works against an adjustable spring

When the engine speeds up, the generator increases the power of the magnet, opens the valve, and admits more air into the intake. Similarly the valve closes as the motor glows down. This apparatus, it is claimed, will increase gasoline mileage from 30 to 90 per cent.

Spiral Chimney Deflects High Winds

ONE novel solution of exengineering problem in
building tall chimneys to wante of winds at high velocity, has been offered by a Brand as deplane engineer who as denigned a strange spiral maney in such a way that it presents a corner to winds from any
direction.

inch, so that the chimney forms a apiral. As a result, each corner at the top of the stack is directly above the middle of one side of the base. Thus, the thrust of a wind w distributed over two sides of the chimney, instead of being concentrated on one side. and this walls will withstand a wind pressure that might demolish the chimney if the sides were flat. A spiral chimney can he built unthout added expense.



Wind pressure is distributed on two sides of this stronge chimney

Recent observations in the Gulf of Mexico have shown that wind morthes of from 120 to 140 poles as hour give pressures of from 77 to 98 pounds a square foot. These velocity records indicate that a chimney built according to the usual rule of 30 to 50 pounds to the square foot might be inadequate in focalities where extreme wind velocities may be expected, or in case the chimney is built to an extraordinary neight. In the case of a 60-foot chimney is

ney at the Tacoma, Smelter, Tacoma, Wash., the unit of pressure adopted in construction was based on a velocity of 125 miles an hour.

Wind Power

Experience has proved that wind pressure at high altitudes is much greater than it is nearer the earth's surface, and also that op small areas there may be a pressure several times as great as the average pressure on large areas.

Press Button for a Smoke



A NOVEL cigarette case, recently marketed, requires merely thumb pressure on a button to extract a cigarette. A spring mechanism pushes a cigarette

rette through an opening at one corner of the case. The next eigerette is pushed into position for ejection, like a cartridge in the chamber of a rife.

Plane and Boat Combined in Speedy Craft



With under body broad and flat, this plane-boat skizes the water lightly, driven by an air propeller

Sixty THREE miles an hour over water in the record of a "hydroniroscepte" recently invented by a Frenchman. The best points of by-droplane and airplane have been combined in the strange appearing craft.

The under body of the water plane is broad and flat, flaring out at the aiden to thin edges. This design provides the maximum lifting power and tends to lift the boat from the water. The horizontal rudder on the tail provides a certain amount of lifting surface that lessens the weight of the hody on the water's surface. A 300-horse-power airplane motor driving a propeller supplies power.

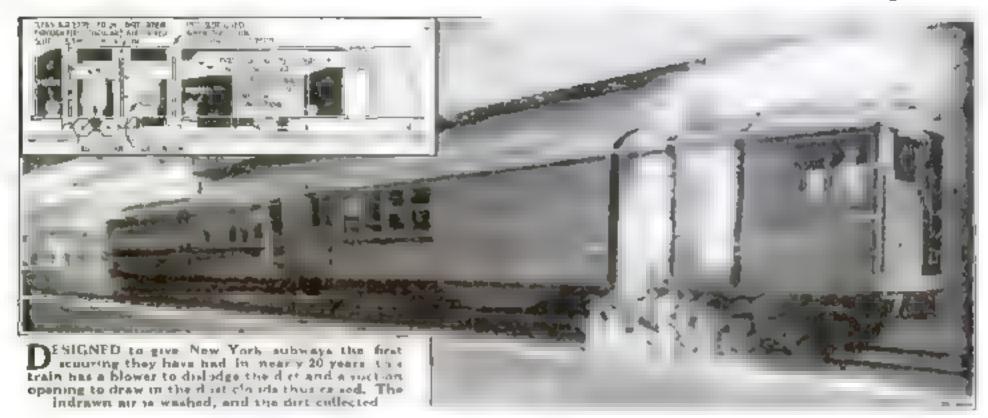


CARRYING a deer into camp is no map, especially if the animal weighs 150 pounds or more and the hunter has bagged his game far from the trail, as many a hunter knows to his cost.

The adentific and essiest way to carry a 150-pound door is to join the fore feet and hind feet together by inserting the hooves of the fore feet through the tendons of the hind feet.

By fitting himself into the "harnom" thus formed by the deer's legs, the hunter can adjust the full weight on his shoulders, while his arms are free to assist in balancing the load as necessity demands.

"Cyclone Cleaner" to Devour Dirt of Subways



Six-Cylinder Auto Engine "Furnace" Heats Twelve Rooms

By Robert E. Martin

BECAUSE the average gasoline engine delivers but 30 per cent of the fuel energy in the form of power and the remaining 70 per cent as heat, F M Minar and G. P. Miner, Jr., of Madison, Wis., figured that it should be useful as a substitute for the usual coal-fed hot water heating furnace with its best efficiency of only 15 per cent. They tried out the idea in the 12-room house of Cyril E. Marks, near Madison, and in the first month claim to have effected a fuel saving of nearly \$40, white maintaining the temperature of all the rooms at 70 degrees

Engine Uses City Gas

The unique heating system consists of a six-cylinder automobile engine equipped to utilize illuminating gas from the city mains, and a special hot water boiler set above the

engine. Circulated in the water incket of the engine, the water, heated a combastion in the agent, rises to the boder. The explosions are timed to occur at the lop of the purion strokes. This decreases the amount

Below Ingenious nechanism for automatic heat control. A thermostat starts the engine whenever the huses temperature falls below 70 degrees of fuel consumed and reduces the speed at which the angine revolves.

The temperature of the water for the heating system is increased also by the hot engine exhaust gases which are piped through a coil in the boiler. After the hot gases have traversed the length of pipe, they have given most of their heat in useful work.

Regulation of heat is entirely automatic in the new system. When the temperature of the house drops below 70 degrees, the point at which the thermostat is usually set, a mechanical device in the furnace room, instead of opening a draft or closing a check, closes two energies motor of the engine, while the other switches on the ignition

At the first explosion of the engine the starter is turned off by a governor built into the engine flywheel and operated by centrifugal force. When the first explosion occurs, the speed of the fly wheel increases rapidly and the connecting wheel of the governor speeds up, throwing two small revolving weights further apart. This breaks the contact and the starting motor



Twelve-room house of Cyril E. Marks, near Medison, Wis , heated comfortably by remarkable "auto-engine" furnace

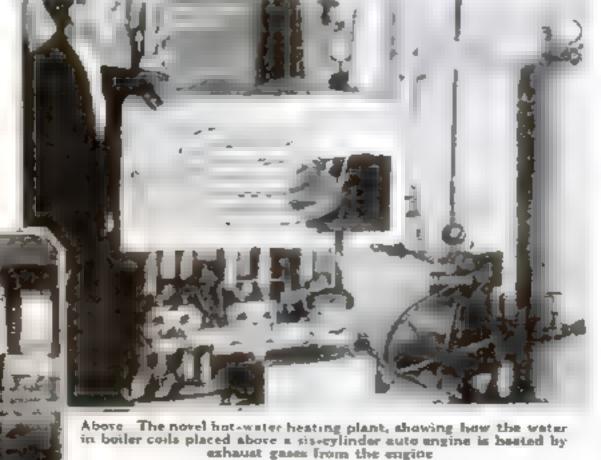
stops. If the engine should balk after the first cough, the starter would come into action and again turn the engine.

The part of the thermontal containing thermometer and regulator is located toward the front of the first floor in the Marks home. As the water slowly cools in the hot-water radiators, and the temperature of the room drops below 70 degrees, the thermostat starts the heating plant.

Requires Little Watching

The engine operates nonelessly and without vibration. The only attention required in the infrequent filling of the lubricating system. Once adjusted for any temperature, the heater operates for weeks without requiring attention.

The floor space occupied by the engine bed is only three by four feet With the 60-gallon boiler, the height of the apparatus is only 60 inches.



Rescued from Desert Chasm by a Bag of Rocks!

How a Makeshift Elevator Saved Injured Motorcyclist from Death Trap

By John Edwin Hogg

HAT would you do if you found yourself, an injured companion, and a motorcycle, trapped in the bottom of a roasting desert cauldron, with coffs towering 75 feet above you, and with the sun beating down upon you at 125 tegrees?

That was the harrowing situation from which, during a recent hunting expedition into the Panamint Desert of California, I finally managed to free myself and committee by the application of a simple mechanical principle.

Hunting for Wild Asses

My companion in the trip was Jack Fletcher, an automobile dealer of Los Angeles. Carrying provisions for a five-day trip, we journeyed into the desert, to the west of Death Valley, to investigate

reports of great herds of wild asses and to have descended from domestic animals abandoned by prospectors.

Reaching a point about 100 miles from civilization, we found the wild asses we were seeing, but aureover to our damay that we had descended into a deep, waterless earthquake fault. It was impossible to drive the motorcycle out by the route we had come down—and there was no other exit!

With the thermometer at 126 degrees and with only 14 quarts of water left, an attempt to get out of the desert stoot would have been suicide. The motorcycle weighed nearly half a ton and could not be moved out of the fault on its own power. So we took the motorcycle and sidecar to pieces, then dragged the parts up the face of a 75-foot of if to the desert above. Then began the tortuous task of reassembling. Toward the end of the fourth day this exhausting work was completed. Our tormenting thirst we assuaged by chewing the watery pith of barrel cactus.

Then came the catastrophe. Fletcher, who weighs 180 pounds, while making a last dash into the guich for supplies, fell down the 75-foot wall, seriously injuring himself. I endeavored to carry him up the face of the cliff, only to fall back utterly exhausted.

It was then that it occurred to me that I might utilize the force of gravity to hoist Jack to the desert above. 80 perambled hack to the aummit and dragged a fallen onge tree to the edge of the cliff, allowing the trunk to protrude into the space above the chasm

After weighting the branches and trunk with rocks, I placed a heavy tow

rope over the end of the tree, lowering the end of the rope to the ledge where Jack lay helpiem. Then descending, I tied the rope about his body. Returning again to the top, I tied a heavy sea bug to the other end of the rope, gradually loading the bag with heavy stones until the weight became greater than that of my companion. Soon his body, swinging clear of jagged ledges, rose to the summst.

Strength Aided by Strategy

But, when Jack had reached the tree trunk, I faced the most difficult problem of all, for my strength was insufficient to swing both him and the sack of rocks toward me. The rope was not long enough to allow the bag of rocks to rest on the ledge below, so i poured gesolme down the end of the rope that held the bag and, after applying a lighted match, grasped my companion's body. Just as the rope parted, burned through, and the bag of stones dropped to the guich below, exerting all my strength, I swung Jack sufely to the ledge.

I hustled him into the motorcycle sidecar, and we began the dash homeward across the desert, to be met on the way by a rescuing party.



"Jack, who was huskier than I, lugged the 200pound motorcycle frame on his back up the steep alopes of the desert trap"



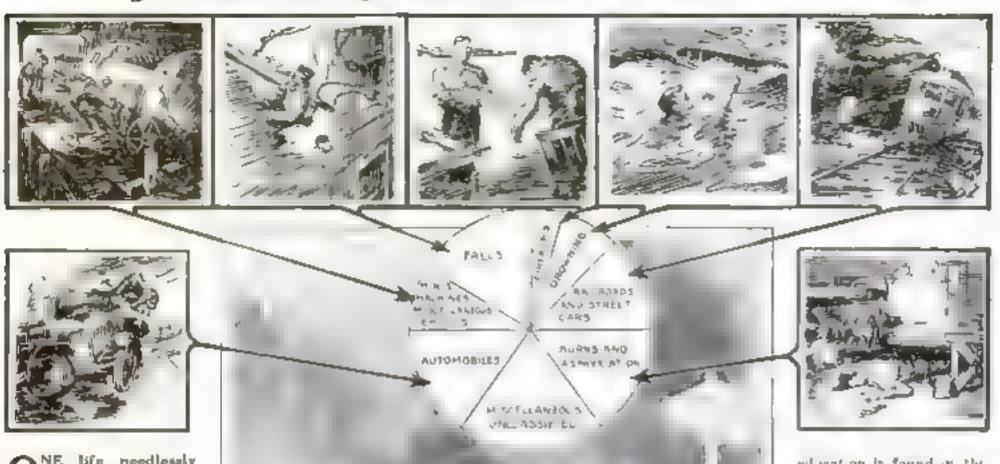
"With the aid of heavy straps, I carried the 150-pound motor like a pack each up the cliff"



The writer (at top) and a newspaper man recoacting the thrilling rescue, showing how bay of rocks was used as counterweight to lift injured man

Accidents Wipe Out 75,000 Lives a Year

Careless America Allows Accidental Death Rate to Climb to nearly Double that of Great Britain—Autos Kill 35 Daily



ONE life needlessly terminated every

Thirty-five lives sacrificed every day to the gods of Speed and Chance.

Five thousand helplans chileren moved down by automobiles annually

Fifty-five thousand men — the support of their families the victims of carelessness each year

TO - stores bring the r own factions will be expressed by at

75.000 cears from the talk assessment of a hage increase to our total death rate, while causing an arcidental death rate almost double that in England and Wales, where there is far greater congestion of

Bullingston

The care essly driven automon le, which stamps out the lives of 35 persons every day, is directly chargeable with 18 000 accidental douths in 1921 a 81y per cent merease over 1920. When it is considered that one eight of all the accidental deaths in the United States are the result of auto non le accidents, this mercuse is more significant than the figures might indicate at first glance and these tigues to rist include non-fatal injunes. For every death by automobile accident in New York City in 1921 there were at least 25 in, ares. It has been est mated that throughout the United States the proportion between injuries and fatabties is between 20 and 24 to one. This means that at teast 260,000, and possibly 300,000 persons, are injured by automobiles every year That careseement is very largely responsible is proved by the fact that general

traffic accidents (against

It is always that the penalties for carelegaess in 1923?

It is always that the automobile causing more than one of accidents. In the first eight months of 1922, eleven of very the same arrange and print is not another product on the same transfer of 1921 was nearly 52, types that of 1921.

was related a section is a air or a stage of the section of the se

Two other causes of a second and our first a terms of a g which claimed 34 ares of any call is 4.1 and burning, which is sed 2 persons over) is. A striking companies, on the second of widespread safety

Hand the state of the state of

With these ministure paper workmen, Frank Morris, safety engineer of Boston, Mass., shows sudiences of workmen that of every 100 accident victims, 33 are killed or injured by falls, 29 by negligence in handling materials, and 23 by machine accidents

reduced on in found at the fact that where there we we control of an inches that we have a property of a fall within the last of

cos ca ware era, industriaaccidents of la nature acla 1921, who public acaccidents of the opene it

Uncle Sam presents a figure of accidental manming bigan John B. D. for he perm to 714 of each mul-Lonishabitanta to be littled by accident each year, while his Best als cousin, by aniety education has cut his annual accidental death toll to 369 a million

The outstanding feature of accident statistics in recent. years to that, although up to 10 . there was a steady decrosse in the number of acde la della la colle communale came to a halt in 1970 and then began to climb upward To what can this peresse be attributed other than to our lack of conscience in preserving human life? How can it be remedied except by an awakening of intelligent Americans, who now stand by while 714 of every million lives are anuffed out by accidents each year, as compared with England's 369

These Modern Baby Athletes Swim and Climb before They Talk

Science Now Debating Value of New Physical Training Methods that Produce Infant Gymnasts

By F. A. Collins

URNING year-old babies into infant athletes has lately become a fad in this country. The story of some of these child wonders who perform astenishing gymnastic feats has set actentists asking whether a regular course of physical exercises may not be good for young babies—whether our present practice of permitting them to play idly without guidance or training is after all the best policy.

Training Two-Weeks-Old Babu

One of America's most interesting little strong men, Matthew W. Jewett, of Saranac Lake, N Y., began his training at the age of two weeks, when his parents allowed him to pull articles small enough for his fingers to greep, such as lead pencils and fingers. To prevent strain, no attempt was made to aid him in the greeping and pulling. Under this treatment the muscles of his hands, arms and shoulders developed so rapidly that in six weeks the baby would hold so tightly to a har as to remain suspended in the sir for an amesing time.

Even more remarkable, perhaps, was the development of Paul Bernary Humphrey,

of Philipshurg, Pa.
The haby's corew hegan at the
age a two months,
who he was put
through a defin a
dell at an o'clock
every morning

The first exercise consisted of holding him upade down, first by one leg, then by the other

To exercise the spine and back, Paul was placed on his back, across the palm of his father's hand, so that the little body curved like an arch. At five months, the baby could hang by one arm; and when held at the knees he could support the entire weight of his outstretched body in a horizontal position, face downward.

Very similar methods of exercise were followed in the training of other buby athletes, notably Florence Proude, of San Bernardino, Calif., who at the age of six is probably America's most skiful juvenile swimmer. Just as soon as she could toddle about, she was allowed to play outdoors in the dew and cold to her heart's content. When only two years old, she began bathing outdoors, and at four she was taking aximming lessons.

New Exercises for Infants

Then there is Jackie Ott, of Miami, Fla., not yet five years old, whose chest expansion is 234 inches, from 2134 inches, normal measurement, to 24 inches, expanded. His exercises, until he was given swimming instruction, consisted largely of the flexing of muscles, on principles similar to those of a new system of child training recently introduced from Germany and illustrated at this page.

Ment Virginia Stainme, Junior diving a nicon of the Paraina Canal Zone a sed her extraord nary physique training on flying rings, until she took up swimming. At five she is a remarkable athlete,

The New System of Baby Exercises

At recommended by the Detleff Neumann school of physical training for children



For Cheet -Baby placed flat on back; legs raised 45 degrees; back supported. Repeated five times

For Neck and Chest Child placed on stomach; feet are slowly rulsed until weight rests on arms. Repeat five times

For Spine and Chest
Child placed flat in his
stomach, arms stretched
outward. Body is then
slowly raised upward by
hands, as shown. Repeated
up and down five times



For Laga - With child lying flat on his back, each leg is bent at hip and lence 10 times



while his father holds his knows. Below are shown in movie strip some of his other daily gymnastic feats

YOU'LL observe that I believe in subjecting the baby's body to rough use "writes the father of husky little Paul Humphrey, describing his baby's remarkable athletic feats, illustrated in the above photographs taken at the age of five months.

"There seems to be no limit to the benith and strength to be attained by a baby through correct exercise and diet. I don't believe in fattening a baby. I aim to build pure blood and nerve exergy"

At the age of six months, baby Paul weighs 18 pounds is 2616 inches tall, and has a chest development of 18 inches. Note that he stood creet five months earlier than does the average normal child



a, though her training did not begin as early as that of some of the others mentioned.

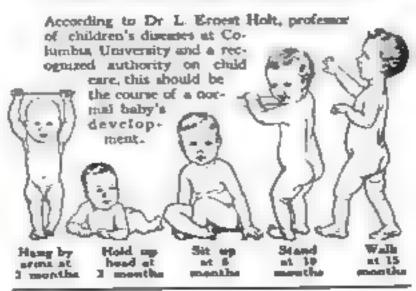
Equally remarkable in Rhoda Cavilt, who could awim before she could walk because her father, an expert awimmer, taught her the motions when she was two.

When she was three, she awam a quarter mile without pause.

Despite increasing interest in such experiments as these, many child specialists adhere to the more conservative belief that regular gymnastic exercise should be deferred until the child approaches kindergarten age-that the baby is his own best physical matructor, and should be allowed to kick and play at will, with a minimum of handling, and no regular physical training before the age of five. They argue that before this period a child cannot properly direct its muscles to carry out the required exercises with beneficial results. According to their rules, the child should be

placed on a soft surface, without any clothen or wrappings to impede its movements. As it kicks, swings its arms or cries, the muscles of its legs, arms and chest will receive sufficient exercise to keep healthy

What Your Child Should Do



When only a few months old, the baby should be provided with simple means for further exercising itself. A pillow should be introduced for it to cumb over, and later a chair placed within reach, which will serve

as a gymnastic equipment even before the baby can stand. The oirculation of the body should meanwhile be developed by rubbing.
When the baby begins to walk,
further opportunities for exercise
should be provided, but the baby
or small child should, according to
this school of thought, be left entirely to its own devices.

On the other hand, there has now come to us from Germany a radical new method of putting baby through gymnastic movements that are and to schieve astonishing results, not only in preserving the bealth and vigor of normal children, but in correcting deformities inherited from defective parents. This method, knowy as the "Detlaff-

Neumann System of Neurode," consists of regular daily exercises for the baby's chest, neck, spine and legs.

The primary purpose of this training is not, of course, simply to develop infant athletes, but rather to lay, early in life, foundations for magnificent health in later

The new system of exercises is simple, Those who advocate it do so with the caution that the bones and joints of a small baby are very soft, and great care must be taken to avoid strains. The exercises are given in the open air, in summer, or in a room where there is plenty of air and warm sunshine. The body is gently rubbed. to stimulate circulation, and throughout the exercises the haby lies on a mattress of medium softness. Following are the exercises, as illustrated on page 39, each of which has a definite purpose.

The chest is developed by laying the baby on its back and, while supporting its back with one hand, raising its feet to an angle of 46 degrees. The action is repeated slowly

five times.

The neck and chest are developed by laying the baby on its face, rausing the feet slowly, until the weight of the body roots on the arms. Thus, also, should be repeated not more than five times.

The chest and spins are exercised by placing the baby on its stomach and rawing the body slowly five times, by the child's arms.

The spinal column and neck are exercised



by placing the baby on its back and caming the body glowly, with the adult's hand placed in the small of the child's back.

The less are exercised by bending the legaat hip and knee, ten times.

These, with slight variations for correcting defects in abnormal children, are the complete exercises. They are repeated two or three times a day.

It is an interesting coincidence that the exercises used in developing a dozen or more of America's "infant prodigies" were simple variations of these exercises, although in some cases not all were used, or were used in a shahtly different form.

Believers in this school of physical education for infants hold that the average baby thus trained will reach early childhood with the physical equipment usually enjoyed only by a few favored children, and that the proportion of school children who are narrow chasted, anemic and physically unfit generally will be greatly reduced. It is important, however, that any training of bables and young children should be harmonious and continuous.

At birth, the circumference of the chest is usually about one half less that of the head. This proportion remains through early infancy. At the end of the second year the measurement of the head, chest and abdonsen should be about aqual. It is not until the third year that the average circumference of the chest should exceed

that of the head.

Those who advocate developing babies by artificial exercise add the eaution that these correct bodily proportions at various ages should be preserved.

"Don't Leave It to Nature," Advises Health Expert



Dr Budene Lyman Fisk

W H A T physical training should f give my child?"

Here's the act twer of Dr. Rugeno Lyman Field, prochical director of the Life Extension Institute. New York City, and national authority on health subjects:

"It is importunt that a regular system of

exercise be commenced with infants as soon as they begin to gain their mancle sense. At no time should the young bodies be swaddled up or restricted the little limbs should be allowed all possible freedom.

"If babies are allowed to kick and rpli about following their own instincts,

much good will result but their exercise may also be intelligently directed.

The persod at which the little body should be trained varies in different cases, and therefore it is in portant that the exact needs of the child should be ascertained. Thus, parents should not during the phyneign after the birth of their child, leaving its physical development to nature. A child should have a regular physical examination, say once in every three months throughout in fancy and early childhood, and an intelligent course of exercise should be presembed by the examiner

"The buby is, of course, a man in ministure, with some 400 different muscles forming a complicated machine I would especially stress the unportance of an intelligent system of exercise when the little body is tender and its future form is being determined.

"Care must be taken, however, to avoid abnormal development. I do not believe in developing physical monstronties. The chest, legs or arms should not be developed out of proportion."

Vegetation on Grazing Lands Mapped with Pantograph

HE pantograph, an instrument employed by draftsmen for copying maps and plans on an enlarged or reduced scale, is used now by the United States Forest Service in making detailed maps to scale of vegetation on sample plots of ground a yard square.

Hundreds of these plots are laid out on the grazing lands of our national forests where 9,500,-000 head of live stock are grazed each year, and are carefully studied for increase or decrease in vegetation.

Usually, the instrument is operated by two men; one mov-



Rangers with pentograph "mapping" a square yerd of soil

ing the free moving pointer arm about the base of each bunch of grass or weeds close to the ground, the other holding the maphoard on which the area covered by the pointer arm is reproduced to ecale by a pencil point. The resulting map consists of a number of irregularly shaped figures resembling in outline circles, rectangues, etc. These represent the area covered by forage plants in proportion to the plot.

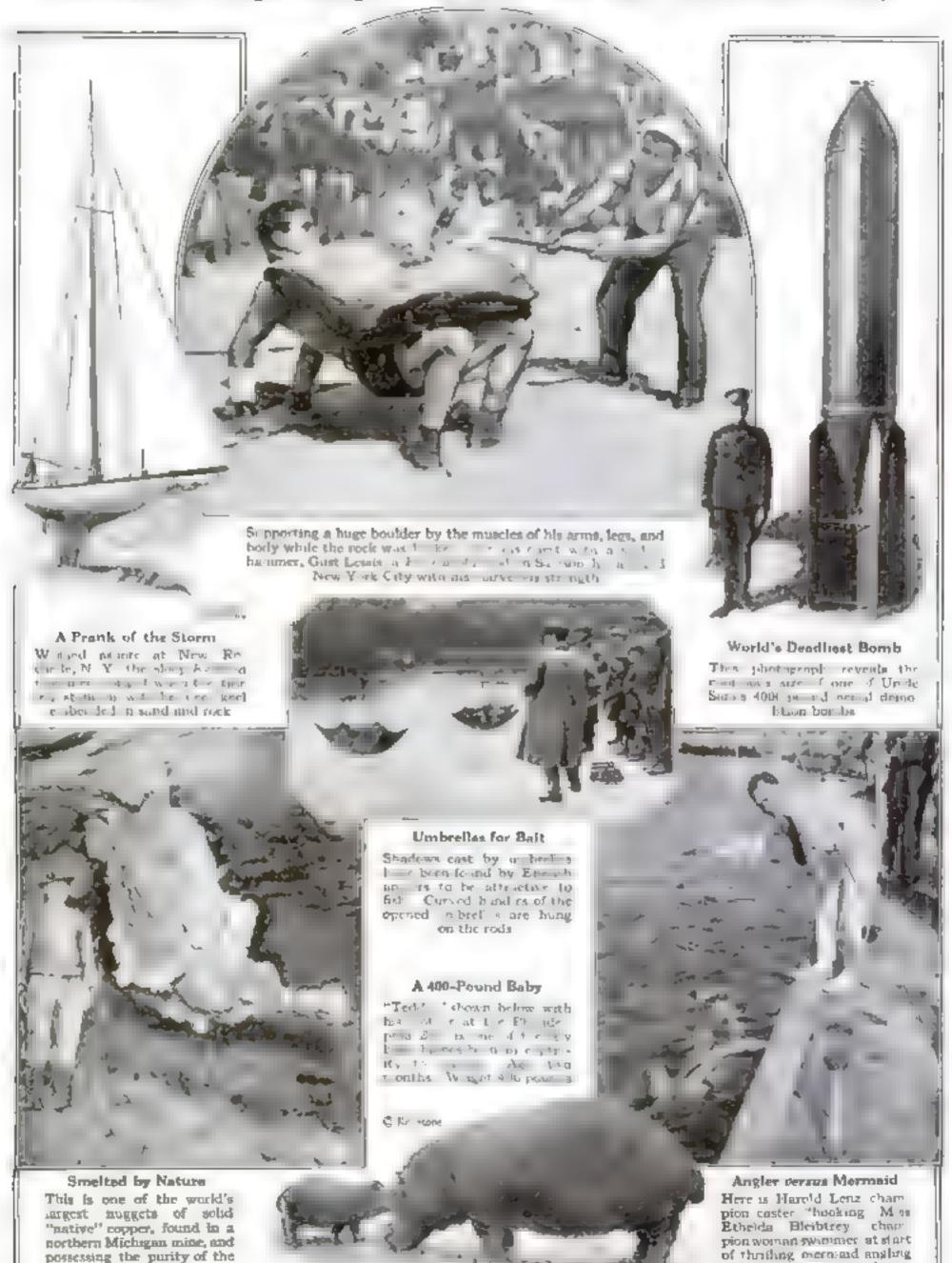
From these data it is possible to determine the percentage of increase or decrease in the vegetation on grazing land.

smelted metal

contest. The mermaid won

Huge Boulder Broken over Modern Samson's Chest

Mermaid vs. Angler-Huge Aerial Bomb-and Other Novel News Photos



Thrilling Race with Flood Saves Cost of Dam

YWINNING agrueling race with flood waters, engineers constructing the Barrett dam on the Cottonwood River, Calif., saved for San Diego more than two billion gallons of water, valued at \$200,000 and thousands of dollars' worth of construction materials. Although the water of the reservoir was sometimes 10 feet higher than the top of the dam they were building to hold that water back, these engineers performed the remarkable feat of completing the dam without loss of water or materials,

A Race with Time

Construction on the dam began in the dry season and it was believed that sufficient progress had been made to hold all the water that might come during the rainy season. However,

the total precipitation was more than 200 per cent of the normal—the second heaviest rainfall in 75 years—and the first run-off raised the level of the reservoir from an elevation of 50 feet to 106 feet. Soon it was seen that the water would be over the top of the incompleted structure, and immediately there began the thrilling race with time.

Concrete piers were hastily thrown out on the water side of the uncompleted dam and between the piers stop planks wereplaced just at the instant that water



Above How engineers by means or an emergency structure was a thrilling race with floods, completing the Barrett dam while he do not that at times ruse 10 feet above the top of construction work.

JAM PROPER

reached the top of the construction work. Thereafter the water was always from two to 10 feet above the lowest part of the top of the structure; yet the main portion of the dam was built while the water was being held back by the temporary wall.

To add to the difficulty, the 14-mile road over which cement was bauled, became impassable and it was necessary to haul over a temporary route about twice as long. At one time all trucks available were mired in soft spots along the road.

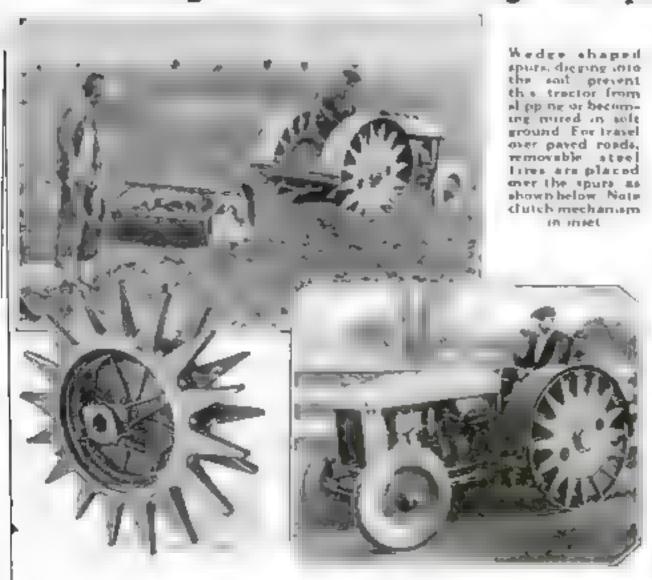
Despite all these difficulties, however, the

dam was completed in record time, making it possible to utilize the full storage capacity for the season's run-off, and placing San Diego in an unusually favorable postion with regard to water supply

Billions of Gallons Stored

The work required the excavation of 75,000 cubic yards of material and the placing of 140,000 cubic yards of masonry in producing a storage especity of 12½ billion gallone of water.

"Walking" Farm Tractor Digs Its Spurs into the Ground



Loss of tractive power result ng from the alipping of tractor wheels on soft or muddy ground is almost antirely eliminated in a new "walking" tractor that literally thrusts its spurs into the ground.

The tires of the rear drive wheels, used only when the machine travels over macadamized roads, are removable, while the spokes are in the form of two rows of wedge-shaped spurs, 10 inches long, 18 spurs in a row. For travel over soft ground the tires are removed and the spurs penetrate the soil.

Staggered Spurs Present Jolts

Spur points are staggered so as to diminish the distance between the points of contact with the ground and thus avoid the julting of the tractor on hard ground. On hard soil there are always 8 points in contact with the ground; on loose ground there are from 12 to 16 points in contact, with a weight on the rear wheels of more than 2000 posseds. With a penetration of six inches, the actual area available for pulling the load is 170 aquare inches.

Each wheel has its individual clutch mechanism which may be released independently of the other drive wheel, making it possible to turn within a radius of 18 1/2 feet

The tractor is designed to obtain the greatest possible effective power and to avoid as much as possible the raising of dust while it is in operation.

Plane Drops Wheels in Midair and Lands on Skids

INCREASED flying speed and greater safety in landing are promised with the invention of a new releasable landing gran that enables the aviator, after ridding his plane of the weight of landing wheels in m dair, to effect a landing on skids. A parachite carries the wheels safely to earth

Many planes have been wrecked accuse of the linch lity of their landing wheels to negotiate rough or swampy land on which aviators were from a condescend. Use of the skyla after make a short stop after make a short stop after make a prough or swampy ground.

The chief obstacle in landing an organized plane on such terrain has been that the wheels have sometimes been the cause of the machine's capazing



Completing 80-foot landing on skide —Lawrence B. Sperry, inventor



Released in matter the whouled goar is carried to earth by parachute, in this manner freeing the plane of useless weight and wind resistance

The chief advantage of the novel landing gear, perfected by Lawrence B. Sperry, son of Elmer A. Sperry, inventor of the Sperry gyroscope, is that when the plane is freed of the weight and head resistance of the wheels, its chimbing power and speed are increased. it will be remembered that Hawker, in his transatientic flight, dropped his landing gear after the take-off. His machine, however, was not fitted with skids and it was necessary for him to trust to luck in finding water or a bog to land on; but he preferred to take this chance rather than carry the increased weight of landing wheels,

Plane Lands in Short Space

Demonstration of the new apparatus at Farmington, L. L., proved that with saids it is possible to make a successful landing within a much shorter space than heretofore. In several landings, the plane traveled only 50 feet along the ground before it came to a full stop. This, of course, tends to prevent crashing into fences or other obstacles when making a forced landing.

Human Eye Absorbs Metal

THAT the human eye is able to completely absorb a piece of steel or iron is claimed by Col. Harry B. to adle of the Officers' Reserve Corps, U. S. A. He says a piece of steel flew into a worker's eye and the iems timue became alightly discolored brown by the oxidized metal. Afterward a magnet is lied to locate the metal that had been plainly visible a few months before,

The Deaf Hear through Their Bones with Vibration Amplifier

PERSONS who are "stoom deaf" may now hear through their teeth, smalls, and the bones of their wrists and knuckles by using a "mechanical ear," perfected by S. G. Brown, Fellow of the Royal Society of England. His invention is based on the fact that we may feel as well as hear noises. The noise of a big explosion at a distance, for example, is felt rather than heard.

Hearing over the Telephone

The new mechanism, of course, extends no hope to persons whose desiness is the result of injury to nerves between the outer and inner ear.

The device consists of a small ebonite case fitted with an electromagnet of the horseshoe type, energised by an electric current from a battery. When a deaf person wishes to hear over the telephone, the wiring is connected with the telephone circuit by means of a small plug on the case. Between the poles of the magnet a small iron har or vibrator is screwed to a brass block and projects through a slot ending in a curved button on the outside of the case. This button, when the device is being used, is presend firmly against the bones of the akull or knuckles. Vibrations of sound amplified by the instrument pass through the bony structure and are received by the nerves of hearing leading to the brain. This result may be accomplished even if the

whole of the outer ear be useless and unrespinsive to the ordinary microphone.

As an alternative to the button, an extension piece shaped like the curved mouthpiece of a pipe is fitted to the outer end of the vibrator and held between the teeth

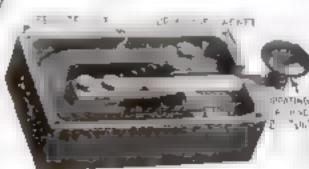
Not the least remarkable feature of this instrument is the distinctness of sound impressions received.



Miss Katherine Steffens, of Detroit, "hears" through bones of her little finger placed on a telephone disphragm.



Placed on a knockle of a deal person's hand, the mechanical car shown below ampaired sound vibrations



How Self-Taught Lumberjack Invented the World's First Endless-Tread Logging Tractor

A. O. Lombard's Climb to Fortune an Epic of the Maine Woods

By John Walker Harrington

BEHIND the scenes in the story of every invention lies a romance that is often forgotten in the thrill of the achievement itself. There may have been a fierce battle with privation, a seemingly endless journey through maxes of detail and red tape, or the surprising development of an unexpected invention from a beginning that promised another outcome.

A Romance of Invention

One of these real remances of life is to be found in the story of Alvin Orlando Lombard, the enstime ax-awinging Maine woodsman and member of the "Lumber Lombard" family, who designed and put into operation the first continuous tread logging tractor, one of the granddaddies of present-day tractors and of the tanks of wartime.

We now know Lombard as a retired millionaire-inventor, creator of the continuous trend tractor, of a machine for removing the back from logs used in paper-pulp making, of a pulpwood crusher, of a machine for separating sawdust and pine knote in sulphite mills, of an automatic device for sawing pulpwood into two-foot lengths for grinding, of a governor for controling the speed of water turbines, and of a score of other useful appliances that are

Less than half a century ago we should have known him as a simple, unachooled woodsman who had nothing to distinguish him from his neighbors of the north woods except his love of finding out the "why" of the crude appliances then used in cutting and hauling logs for the mills and his desire to make possible time and labor saving

changes in this equipment.

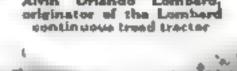
Of the family of Lumber Lombards who migrated long ago from the sunny bills of Lombardy in Italy to the snow covered mountains of Maine, Alvin Lombard at eight was banching all the shingles for his father's mill

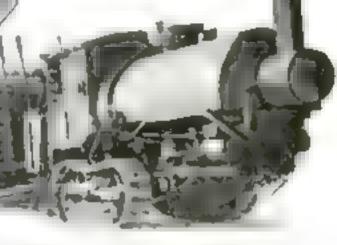
From the Bottom

In doing this monotonous work he mastered the secrets of advancement that have made hum a successful inventor and a millionaire. At 12, Aiv n was considered the most expect shingle buncher in Maine. At the age of 13, he got his first taste of the operation of machinery when he began sawing

with his father's shingle-machine. In the meantime he had picked up some reading and writing and arithmetic and delved with surprising seal into the realise of higher mathematics.

Alvin Orlando Lombard, printing of the Lombard





installed at the gate of a waterwhee, used in generating power for the gener-

ating plant of a street railway in Ban-

Lombard, inventor. Recognizing the

value of his invention, he turned from

lumbering and milling to the manufac-

ture of governors, remaining in this

business for six years and then selling has

plant and devoting his time and capital

Right there began the career of Alvin

Lombard's original continuous tread locomotive log hauler which he claims was the "granddaddy" of all modern tractors of this type, was capable of dragging sleds laden with 50 tons of logs

The lumberlack, us a young man, designed and built his first sawmill from "piace in his head." While operating the mill, having had experience as a lumberlack, swamper, river driver, and sawyer, he saw the need of a regulator with which to govern the speed of the water turbine from which he obtained his power.

No one he knew had ever heard of such

to the development of other inventions already mentioned.

One of the problems that Lumbard had been turning over in bla mind all this time was the knottest in the American lumber industry: "How to get out the timber" The problem had been solved in a measure by the use of logging railroads, but tracks and wheels had limitations. In Wisconsin.

George Glover had tried to meet the need by designing a steam angine that carried extra steam and a special tank of hot water to be used for melting anow in front of the engine. The idea was that the anow thus mested would freeze as soon as the engine passed over it and form ice over which the logs would slide. In practice the engine failed

Locomotive on Treads

Lombard finally solved the problem and placed on the market in 1908 what he claims was the granddaddy of all present-day tractors. He used for his purpose a steam locomotive placed on two end-

less chain treads, each made of plates mounted on two large wheels. "This," says Mr. Lombard, "was the first commercial workable continuous tread type machine

(Continued on page 46.

"The Other Parent of Invention"

If NECESSITY is the mother of invention, persistency is the other parent—and the remarkable mechanical achievements of two pioneer woodsmen, described on this and the next page, are vivid illustrations of the fact.

Two atriking and widely used applications of motive power with which we are familiar today we owe respectively to the persistent inventive efforts of an untutored Maine woodsman and of a Michigan loader.

Between the lines of these brief sketches, telling how the endless tread steam tractor and the tremendously powerful Shay locomotive were invented, you will read the recipe for success in invention—

"First, the idea; then unconquerable grit in ex-

an appliance, so he invented one and persuaded his brother, a machinist, to build it.

The regulator was so successful that intmediately a larger one was built and

Another Inventive Lumberjack

JUST as lumbering necessities in the Maine woods forced Alvin Lombard to invent a continuous tread tractor, ancestor of the tractors we know today, so hard times drove another pioneer woodsman, Ephraim Shay, of Michigan, to device a novel wood hauling angine, parent of the powerful vertical-cylinder "Shay locomotive," med today for pulling tremendous loads in railway yards and on steep grades.

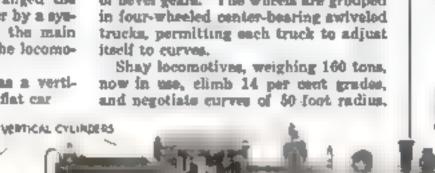
in his first efforts, back in 1870, to solve the log hauling problem, Shay tried a tramway running on maplewood rails, and drawn by horses. The horses were killed by brakeless cars going downhill. Next, he tried a light locomotive, but the drive wheels ruined his wooden rails, From this experiment, however, be gained the idea that the efficiency of a locomotive could be increased by transmitting power direct to the trucks through a shaft, instead of through drive wheels. Shay removed all the drive mechanism, then rearranged the engine so as to transmit power by a system of gears operated from the main shaft to the trucks of both the locomotive and tender.

Shay's first locomotive, was a vertical engine botter placed on a flat car



Shay's first locomotive, consisting of vertical engine and boiler mounted on a flat car

The modern Shay locomotive has a three-cylinder, vertical engine, driving a horizontal shaft, made in sections, and joined with flexible couplings. The shaft extends the entire length of the engine, and drives all the axios by means of bevel gears. The wheels are grouped in four-wheeled center-bearing awiveled trucks, permitting each truck to adjust itself to curves.



Two modern truck-drive Shay locomotives weighing 10 and 40 tone respectively. Note on each locomotive the three-cylinder vertical engine and the horizontal drive shaft.

The new machine revolutionized the lumber industry, proving capable of dragging sleds and wagons laden with from 40 to 50 tons of logs and plowing through snowdrifts and underbrush.

(Continued from page 45)

The First Lombard Gas Tractor

Lombard did not stop at that. With the vogus of the gasoline engine, he adapted it to his needs and produced the first gasoline endless trend tractor, which, curiously enough, was used first, not for the lumber industry, but for hauling from place to place a traveling moving-picture and vaude-ville show. And, in order to accomplish this success, the former lumber; ack had to study and master the details of the tensile strength of metals, for the tractor, to be of use, must be just as effective in the heat of summer as in the co.d of the north woods.

The "aurprising sawyer" has not changed much since his early days as a woodsman, despite his accomplishments. Since his retirement from active business, Lombard has been at work on new inventions on his estate at Waterville, Ma., where, in his workshop, he spends much time working out models of needed inventions from "plans in his head."

A Remarkable Workshop

The inventor who complains of lack of funds, schooling, and equipment, should find real inspiration in the story of the unschooled lumberjack who looked forward,

worked out revolutionizing inventions, and by his own efforts made a living and a fortune.

His sociuded shop is situated beside a stream from which he draws the power to operate his mechine tools, and the speed of the water-wheel that runs his dynamo is regulated by the very governor

which he invented. Sometimes, for recreation, he chops down trees with all the skill that marked his undergraduate days as a lumberjack in the Maine woods.

Harnessed Mud Turtles Clean Clogged Drains in Michigan Town

MUD turtles are earning their salti Strapped in little barnesses to which are attached long leashes, they have been put to work in the town of Hulsdale, Mich., plowing through silt and refuse that clogs long drampipes, and saving the town about \$500 a year (for which the turtles receive

their board and lodging). Hillsdale, like other towns, has countless drainpipes lying a couple of feet below the surface of the streets, to earry off supplus run and melted snow into the sewers. Some of the pipes are several hundred feet long-a circumstance that is no drawback until the tiles become plugged with mud. Then the usual method of cleaning by shooting a powerful stream of water through the drain is of little

avail.
Sometimes it required several days' work to clear one drain.

until the superintendent in charge, with the subject of mud continually on his mind, thought of using mud turtles to clean out the caked silt!

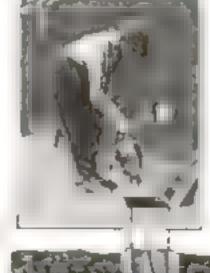
First he caught one of the leatherbacks. Then he fastened a hurnous to its shell. To the harness he attached a string a trifle

longer than the drainpipe to be cleaned, and to the free end of the string a piece of chain. Then be placed the turtle, head first, into the clogged drainpipe. And the turtle, who dotes on burrowing, didn't require much urging to dig into the mass of silt. If the animal stopped and rested too long, a

jerk on the line started him on his way again.

Thirty minutes after the start, the turtle emerged from the other end of the 200-foot drain. The string and chain were pulled through after him, and a stream of water from a fire hose completed the cleaning that before had seemed a hopeless task.

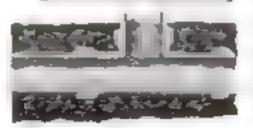
Now, among its untisted assets, the town owns six drain-cleaning mud turtles — truned experts that live in a special pend and est special food—a fitting and satisfying reward for their services.



A 30-Minute Job

Photographs and diagramshow how a harnessed mud turtle is employed to clean clogged drainpipes. The turtle is lowered into the drain, where it quickly burrows through the silt emerging at the other end. After the passage is cleared, the drain is flushed with a fire boxe.





Novel Counterweight Bridge Opens in 90 Seconds



frame, while the bridge proper is pivoted at the base of the frame. Bridge and counterweight are connected by jointed girders.

When the bridge is down, the counterweight is suspended in a horizontal plane, where it is locked against movement by racks and cogs of the incline. When the bridge is raised, the counterweight swings

> downward in a half circle, while the motor house moves down the incline in front of it.

Less Power Needed

This arrangement is said to require less power for operation then the ordinary bascule and is quicker in opening and closing the bridge. A 100-horse-power electric motor opens and closes the bridge in 90 seconds.

An extra motor is provided for use in case of a breakdown. A gasoline engine that will open the bridge in eight minutes is also available.

Concrete blocks, each weighing 2500 paunds, make up the 1000-ton counterweight. The movable span is 162 feet long in the power house is mechanism that prevents operation of the bridge until all signals are set

accurate model specimen of Florentine art,

even the furniture being carved in the character of the period. The model will

soon be exhibited in the United States.



The ordinary bascule operates simply as

Powerful Telescope Five Inches Long

ONLY five inches long when fully extended, this pocket telescope will magnify 4 % times.

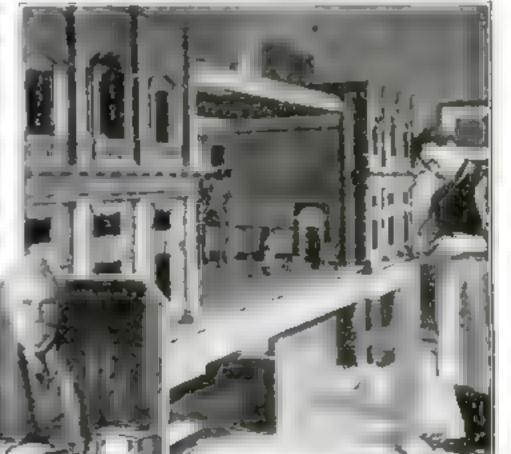
Such large magnification combined with a short focal length has been achieved by improved lens grinding and perfect mounting. The border of prismatic color in most inexpensive field glasses has been avoided by a new combination of glasses and the arrangement of apertures. The glass contains a concave-convex fint objective lens with a double convex crown and a double concave fint eyeptece.

The World's Most Elaborate Doll Palace

THE most wonderful doll house in the world—"Titania's Palace," 214 feet high, and covering 60 square feet—has just been built in Ireland by Major Sir Nevile

Wilkinson, Ulster King at Arms, with two was starts Create and take little argue that postage starts, briese-brac out of the size opens and marble and ivory statuary small returns, all precisely to scale, form the furnishings of the primature palace

The palace is an



"Titania's Palace" above and the builder, Major Sir Novile Wilkinson at left exhibiting manature Florentine furnishings

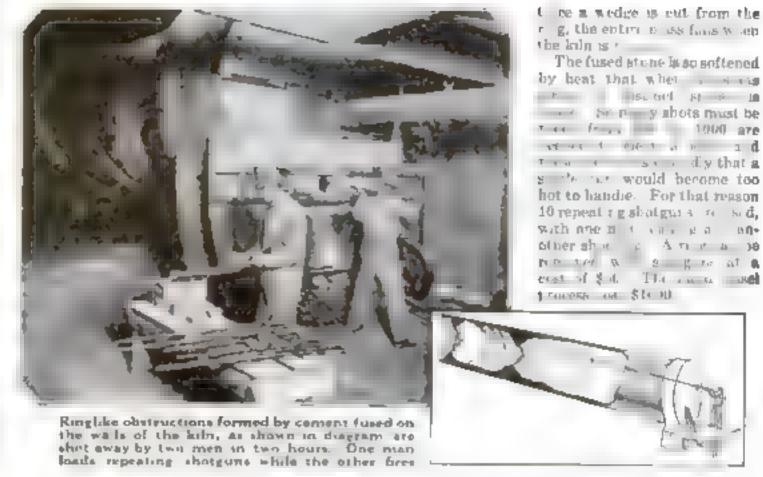
Marksmen Clean Cement Kilns with Shotgun Bullets

COMPLETING in two hours work that formerly required two or three days, marksmen armed with shotguns are now making sport of the once arduous task of cleaning cement kilns.

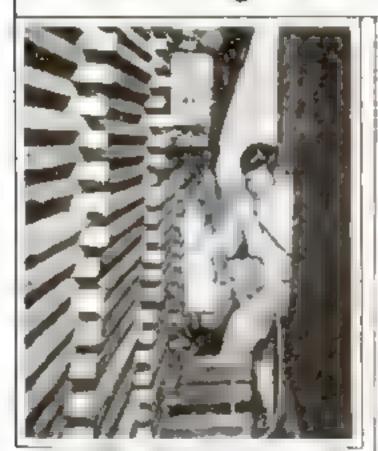
Bullets Replace Chisels

With charges of one-ounce lead bullets they shoot from the bot iron walls of the kiln accumulations of cement that formerly were cheeled out by hand after allowing the kiln to cool. These accumulations are caused by the intense heat which, when applied to the ground atone and other raw materials in the rotating kilns, fuses some of the cement to the iron walls in the form of a ring or crust that blocks the kiln.

The marksman, standing at the opening of the kiln, cuts away the ring by repeated shots from 12-gage shotguns.

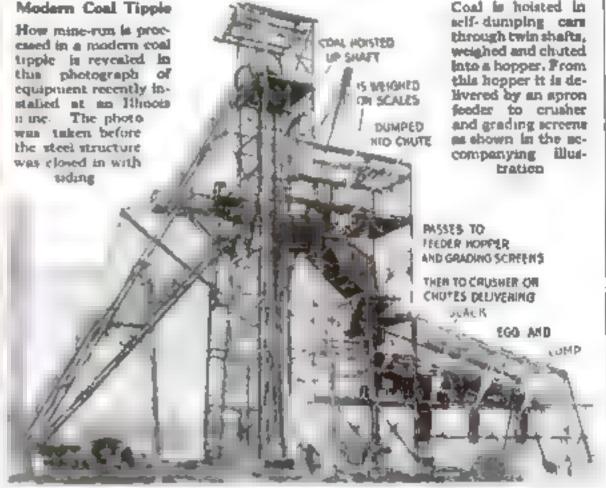


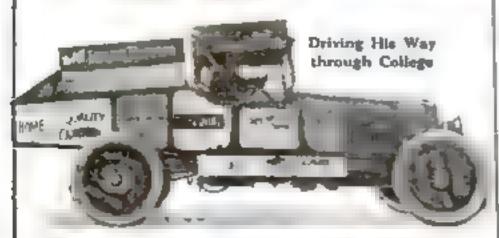
Half a Page of the Month's Most Novel Photographs



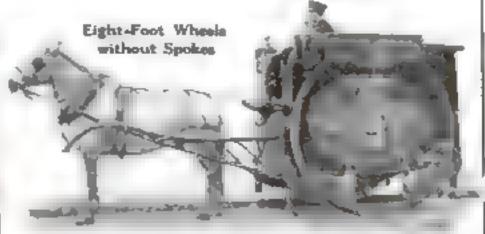
Chemical Fumes Test Air Currents

To indicate air movements in a dry kiln, chemical fumes are now being used. Fumes of hydrochloric acid are blown across ammonia, producing an abundance of harmless, visible fog





Belling advertising space on his car enables Jack Rasberry to pay his way through the University of Texas



Giant spokeless wheels support a strange advertising wagon. The rims are supported by hidden roller bearings

How Skilful Tool Users Win Fortunes Building Models of Famous Old

Ships for Millionaires

"THE building of ship models is undoubtedly established as one of the fine arts, and has wonderful possibilities of development.

"All ship models have a decorative value, while the finest examples are objects of real beauty that cannot fail to give the same pleasure we gain from a painting or statue. Many arts contribute to make these models beautiful.

"In the sixteenth century the designing of ships reached a degree of perfection that has remained unrivaled. Ships constructed then were among the greatest artistic achievements of their time, and in reproducing and preserving them we perpetuate objects of absolute beauty." — HENRY B. CULVER, America's master builder of ship models.

F YOU should visit a certain remarkable house just a shout away from the teeming throngs of Breadway, in New York, you would find there a studious, busy man wearing the smock and shell-rimmed glasses of the artist; and on the workbench before him you would see a fascinating and beautiful model of a gullant man-of-war that sailed the seas in olden days, reproduced to the tiniest detail with marvelous crafteman-

Substantial Rewards

At first glance you might believe you were in the workshop of a maker of heautiful but useless toys—until you learned that for this one ship model the maker was to receive more than \$10,000! Then you would understand how lienry B. Culver, now known throughout the

world as a master of ship model building, has become a recognized leader in an amazing modern revival of this ageand art-craft.

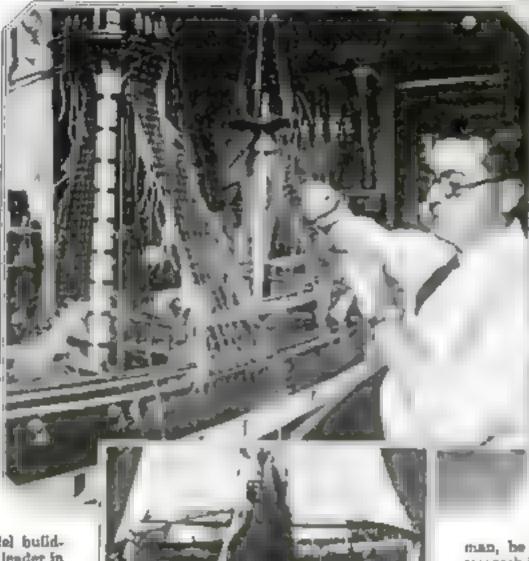
America, in a few short years, has taken the lead in this revival, turning out intricate works of craftsmanship as costly playthings for Fifth Avenue palaces. An ever-increasing number of artist-shipbuilders—amateurs and professionals—are now receiving for their faithful reproductions of famous old wooden vessels of history fees ranging from \$100 to \$40,000. And the master craftsman of them all, Henry B Cuiver, has made no fewer than 100 ship models within a period of 15 years, receiving for them usually not less than \$3000, and for one, a masterplece, more than

Fascinating as Business or Hobby

\$20,0001

But aside from liberal rewards, the professional ship model builders, as well as amateurs who follow model making as a hobby, agree that it is a most fascinating pastime for any person who is skilled in the use of tools.

It was this fascination, with the promise of substantial reward, that drew Henry Culver into the profession of ship model building some 15 years ago. But



Carvings that adorned the famous ship, "Sovereign of the Seas," were exactly reproduced by Mr Culver and his assistants, as shown above. It took three years to build the model of this magnificent vessel—longer than the time required to build the original

Famous

Man-of-War,

of the Sees"

"Sovereign

The

World's

Ship Model

Finest

The master workman in America's twittel of the ancient art of ship model building "Henry B. Culver - is shown above adjusting the rudder on one of his marvelous reproductions of sixteenth century men-of-war, for which millionaires pay him from \$3000 to \$20,000

At the left Mr. Cuiver le shown at work on the deminutive ahip's shrouds which are almost as delicate as lace. This threads that reproduce the ropes of gallant vessels of the past are fastened with real sailor's language.

before he built his first model, he laid elaborate foundations for perfect craftemanship. Though at the time he was an experienced and practical yachta-

man, be spent months in preparatory research in the libraries and act galleries in America and abroad, collecting all manner of data on the original vessel which he was to model.

Wanted-Experienced Shipbuilders

Then began a search for men whose experience qualified them for constructing units of a perfect reproduction of a historic salling ship.

Assembling the intricate parts created by his assistants. Culver finally completed his first ship model, which he sold imprediately to a commisseur who appreciated its astonishing perfection of

The building of ministure ships that never sail is by no means a new calling. Remarkable examples of the art have been discovered recently in ancient Egyptian tombs in a remarkable state of preservation.

Many of the earlier models were built by old retired sailors who had unlimited time and patience. The most famous of these are the "beef bone" models, carved by British sailors from places of beef bone, some of which are three feet long whittled out with surprising detail.

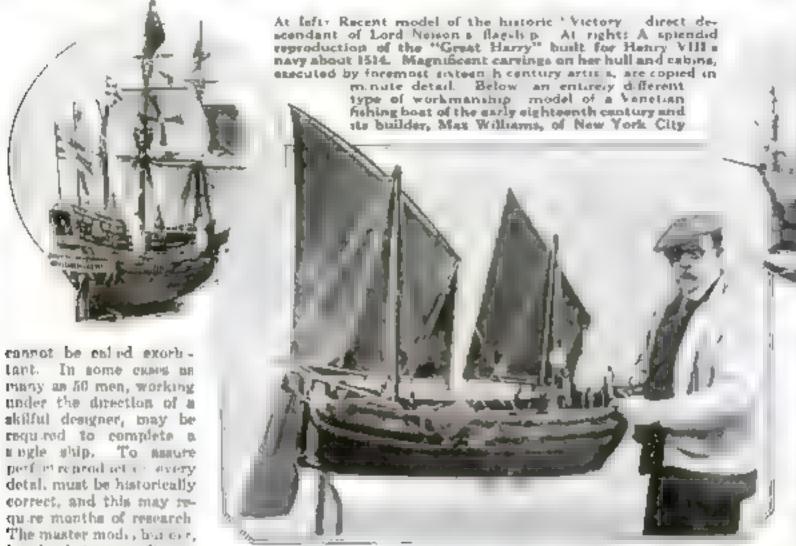
The present demand for ship models has been created largely by the degree of

wealthy families to have reproduced the versels that helped build up their fortunes. One New Englander whose great-grandfather was a prominent figure in the clippership era at Boaton, recently ordered models of 60 shape that had been owned and commanded by his ancestors. The prices be will pay for these ships range from \$500 to \$1000

Considering the time and care required in building a faithful model, these prices Every small thread must be placed exactly as the ropes were arranged in the original type of ship, whether schooner, brig, or barkantine

An extraordinary and extremely valuable model of the famous old British man-ofwar, "Sovereign of the Seas," of 1637, reproducing the elaborate carvings and gaily colored ornaments that were the marvel of the seventeenth century, is a striking example of the intricacion of the model

first constructed a wooden core slightly smaller than the hull, in removable sections. Over this core were built the stem. sterapost, keel, and ribs of the model Then outer planking, one eighth inch thick was nailed on. When the core was removed, the lower decks, with gun carriages and buikheads, were placed in position. On the carriages were mounted more than 100 miniature bram cannon, each with a crown, royal cipher, and designs molded on it.



Place coursesy Max W. Blates

besides being a craftaman

must be an artist who can pass intelligently on the artistic reproduction of highly ornumental wood carvings. guns as they were mounted on the original chip, the color scheme and gilding, and finally the general effect of the complete model -for a ship cannot be reconstructed exact-

ly to scale. If this were done, the most and spars would appear too small.

Modern ship modein full into three general classes. In one kind the hull be carved from a solid block of wood, usually mahogany. The second is built from a cradle or ribe, just as a real ship is built, Most model makers are using a third method-a laminated, or "bread and butter" hull. By this method, thin strips of wood are glued into a solid block the size of a ship's hull in such a way that the laminations will imitate the details of the ship. The rough block is shaped with wood carvers' took chisels, gouges, files, and sandpaper—and the craftsman works to the bundredth of an inch in order that the true scale may be Then the musts are preserved. stepped, the yards slung, and the intricate task of hanging the rigging begins.

Threads Spliced like Rope

Sometimes the delicate threads used for rigging are spliced just like large ropes. Tiny blocks and dendeyes are introduced so that the yards of the model can be trimmed by running rigging. maker's art. This reproduction—the work of Henry Culver-measures 60 inches over all and in generally considered the finest of its kind in the world. Fifty men spent three years in its construction.

Following working drawings of the "Sovereign of the Seas," the model makers

were fitted. Details of the claborate preamentation of the atern and siden, and of the intricately carved projecting peak, or prow, with its equestrian figurehead, were made piece by piece Fach decoration was modeled in plasterine; then gelatin molds were made from each, and finally duplicate plaster casts were taken, from

Next the forecastle. quarterdeck, and poop

which the carvers worked

All of Culver's models have hollow hulls and the construction throughout is surpriningly light. A complete ship model three or four feet in length may weigh loss than five pounds. The complicated rigging of the great ships when reproduced in

> miniature resembles a delicata lacework. Even soilor's knots are reproduced in the thread "ropes."

Probably only half a dozen men in America possess the experience and ability to complete such an introcate task, which often requires more time than did the building of the original ship.

There are, however, scores of ship model builders who are skilled in less exacting craftsmanship, and many of these make an extremely good living from their work. One is a sea captain, who retired 30 years ago. At the age of 30 years be took up model making as a bobby and now sarms more than as a sading master.

Amateurs at Work

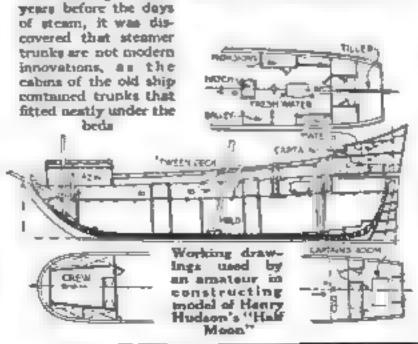
An increasing group of amateurs who have become interested in the revival of this ancient artcraft includes men from all walks of life. At present they have on their benches models of Culumbus' "Sauta Maria," Hudson's "Half Moon," an Egyptian galley that satied 2000 B.C., and an American clipper, "Flying Cloud," the fastest sailing ship ever built.

Some New Facts about Old Ships

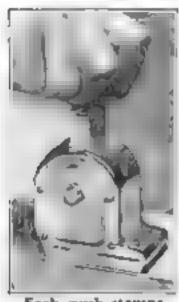
SOME surprising facts about ship construction in the olden days have been uncarthed by artistcraftunen who build thip models.

One builder, for example, discovered that radical changes were made in the famous American frigate, "Constitution," after every battle, even the mainment being moved 10 feet forward between the time she left the ways and the close of the war of 1812.

In making another model of a ship in service 50



Hand Pressure on Plunger Stamps Envelopes



Each push stamps an envelope

"RAPID A fire" stamp affixer, which stamps envelopes se quickly se n person's band can manipulate a plunger, has recently been invented and is being marketed by a Boston manufacturer. little machine is operated by using coiled government stamps. As pressure is applied on the plunger, the ma-

chine moistens the envelope and sticks on the stamp.

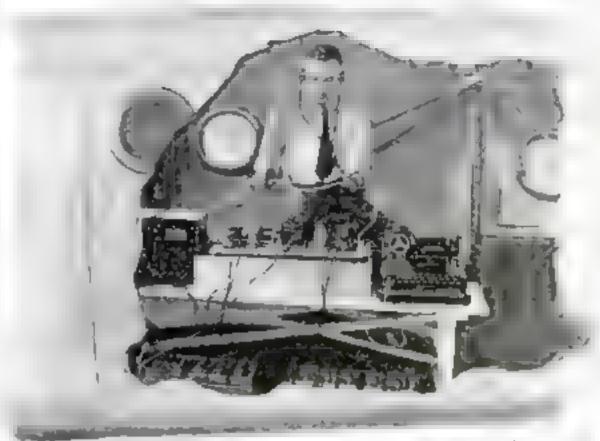
A Sheet of Rain 12 Feet Thick, and What It Did

Two hundred and forty inches of rainfall over an area of four square miles, within half an bourt

Can you imagine what such a cloudburst would mean in a big city—a sheet of water 12 feet thek crashing down, wrecking buildings and perhaps drowning thousands?

Read, in next month's inne, a dramatic syswitness account of the most colessal cloudburst in history a 60-foot wall of water that recently wrought amazing destruct on in the Sand Canyon of southern California.

Planes to Receive Typed Radio Messages



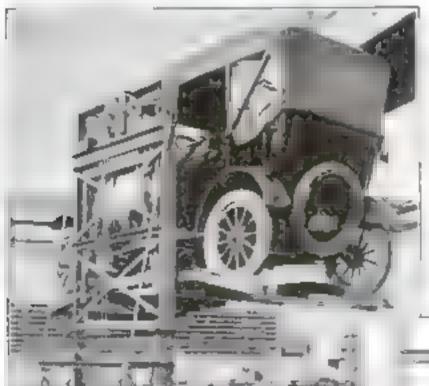
tut-away view of cirplana fundage, showing how operator will receive typed radio messages

RECENT successful tests with the teletype in transmitting type-written radio messages between the naval air station at Anacostia and the Bureau of Standards in Washington have led to further experiments looking toward the exchange of such messages in the immediate future between stations on the ground and moving airplane stations.

In transmitting, the message is first transcribed on a machine that translates the letters of the alphabet into dots and spaces of the so-called fiveunit code and punches them through a paper ribbon. This ribbon is passed through an automatic transmitter that broadcasts the codified message with the sid of electric generators and thermionic valves, building up a current of the requisite power and high frequency

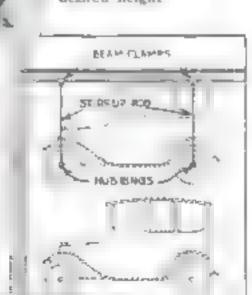
In the receiving station the radio impulses pass through a recording instrument that retranslates the dots and dashes into type and prints it automatically on a paper ribbon

Autos Hang from Ceiling in This Garage



SPACE is conserved as do not be bandling simplified in a Buffalo, N. Y., garage through the use of an elevator that lifts an auto to a storage balcony or to the century, where it may be suspended by storage rods.

The elevator is placed in front of a car so that the wheels may run onto choosel front tracks of the elevator. Then the wheels are tragged and, by turning a wind ast, a workman races the loaded elevator to the desired height



By this stevating platform the auto is lifted to a storage balcony or to the spiling, where the car is suspended from a beam, as shown in diagram



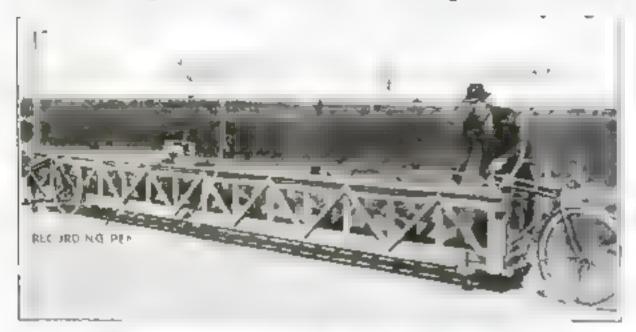
Compressed-Air Tool Blows Old Paint from Walls

OLD point blaters can be blown off the house by a compressed-air point remover recently invented by Mr. E. T. LaRoche, of Philadelphia, Pa., to replace the old method of blowtorch and acroper.

The new invention is a combination scraper and blower. Compressed air is blown toward the point of the scraper from an outlet situated about two inches above the under surface of the cutting edge. As the operator, applying pressure to the tool, moves it over a painted wall, the edge of the scraper cuts under the paint in several places. The compressed air then blows off the paint that the scraper has loosened.

The compressed air is supplied by a portable outfit and is led to the scraper through a flexible hase.

Girder-Cycle Measures Bumps in Road



ACCURATE measurements of the unevenness of a roadway following the completion of traffic tests upon it, are now possible by means of a recording device originated by the United States Bureau of Public Roads.

A latticework girder, suspended from cycle wheels, furnishes a perfectly flat surface over which the recorder moves. A small wheel, making contact with the road surface, communicates the varying contour to the recording pen as the operator by turning a crank draws the carriage along the length of the girder.

Minute undulations in road surfaces can be recorded by this device

Why Frozen Milk Breaks Its Glass Container

WHEN a bottle of mick freezes and .breaks its container, the desater should be blamed on the water that comprises 67 per cent of the volume of the

milk. When water is cooled, it contranta until a temperature of about 88 degrees F. is reached, then, due to a change in the molecular structure of the matter, the volume commences to increase. The Increase in practically greatstible.

In the Illustration the expansion of the water forced the frozen mixture out of the top.

But the cooling was carned out so

rapidly that the pressure was relieved too slowly and as a result the bottom of the bottle burnt.



How expansion eracics the bottle

Football at Long Distance on New Scoreboard

HUNDREDS of miles away, the helfback plunges through tackle for 10 yards, and the fans at home rour with appreciation. They have followed the play in all its detail on a new mechanical football georeboard invented by the staff of The Deserted Names, Sait Lake City, Utah.

The black aquare ruled to represent the gridiron is made of sinc. Concested behind It is a moveble electromagnet moved by the operator in response to directions telegraphed from the side lines. The small fron ball on the outside of the board follows the magnet, and travels up and down the board, depicting every move of the gume.

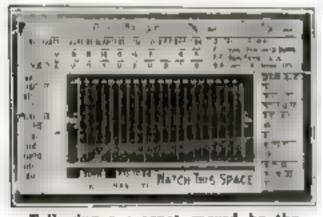
A slide, marked "Ball," indicates which team is on the offensive. Arrow indicators



Height to which the small weight rebounds measures tone of the muscle

IN STUDYING the effect of fatigue on the muscles of athletes, Dr. R. W. Schulte, of Berlin, Germany, has developed an ingenious measuring apparatus to determine exactly the degree of fatigue after certain exercise and after prolonged continuation of muscular activity.

Suspended from the adjustable arm of a weighted supporting stand is a glass tube with stehed-in cultbration marks. This tube is placed vertically, with its lower and resting on the muscle to be tested. When the observer presses a trigger, a small metal ball, beld by a catch, is released and allowed to drop on the muscle. The better the tone of the muscle, the higher will be the rebound of the metal ball, which is sacortained by the observer by reading the calibration marks. By comparison the degree of fatigue and the speed of recuperation may be ascertained

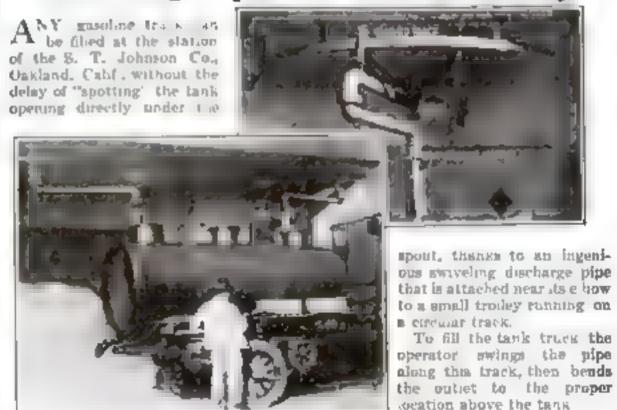


Following a magnet moved by the hidden operator, the ball indicates

point to the name of the player carrying the ball. Cards inform the spectators of the down and the yards to gain, while in a larger slot appears such special informsttion as "Forward pass complete," By having a direct wire to the football field, each play can be reproduced on the board a few seconds after it is made.

A THEORY that dyes of various colors, applied to the intestines, will kill duesse germs has been tested, with claims of success, by Dr. Paul A. Lewis, of the University of Pennsylvania, in experiments with thousands of color combinations.

Swiveling Pipe Fills Tank Quickly



Clock Is Driven by Its Own Weight

A SILENT clock that indicates by its position on its

upright supports when rewinding is nucessary in propelled by force of gravity acting on the timepiece.

To set the clock in motion the entire mechanlam, including the face, hands, and pendulum, in raised to the top of two vertical pillars forming its support. Ratchet wheels on the elock engaging a rack out into the side of one of the pillam transcrite



As the clock runs down, it slides down the pillare

the gravitational force to the pendulum and balance. As the clock runs down, its position on the pillars becomes lower

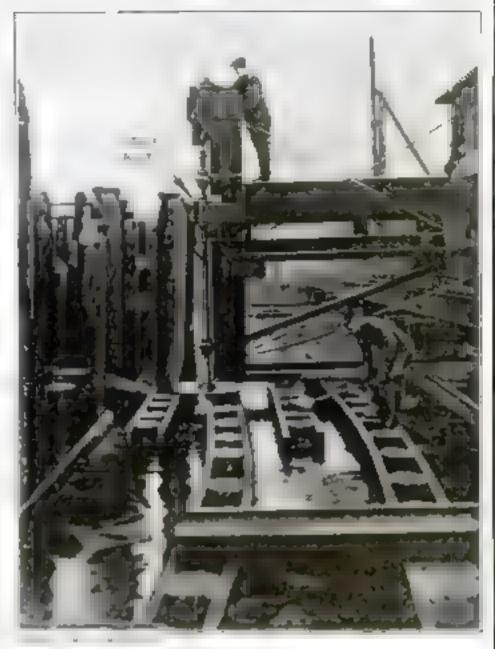
The pendulum consists of a vertical bar pivoted at the center near the escapement and bearing at its ends adjustable weights. By altering the position of these weights the motion of the pendulum is controlled

break, this clock is the last word in simplicity

Circular Saw Can Cut Piles Below Water

A CIRCULAR saw that cuts 75 piles an hour when submerged under water is being used on pier work in Phiadelphia, Pa Over 7600 pile heads are to be removed

The outfit consists of a 48-inch circular any bttached to the bottom of a long shaft operated by 85-borsepower motor on its upper end. A traveling bridge mounted on wheels rune the entire width of the pier, driven by a compressed air engine. Two 14inch I-bearns on the bridge act as rails for the side movement of the naw rigging. It is possible to cut off 226 poles in three bourn when the water in at low tide A workman standing at water level cools the saw by dashing water on it when not submerged

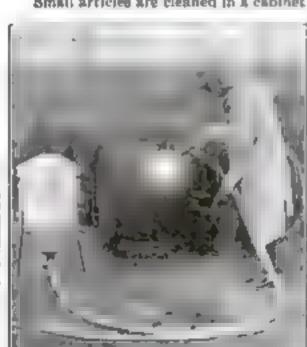


Mounted on a traveling bridge, the saw is attached to the bottom of a long shaft

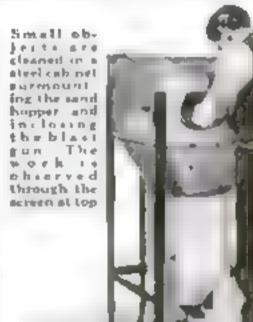
Portable Sand Blast Cleans Quickly

EVERYDAY use of the sand bleat for all kinds of difficult eleaning has been made possible by a new portable outfit that is simple and effective in operation. The invention consists of a new blast gun that can be used alone or in connection with a cabinet. Compressed air, controlled by a trigger in the handle of the gun, passes through the air jet and creates a vacuum by which the sand is sucked from the hopper into a mixing chamber. The air pressure is regulated to suit the requirements of the article that is being cleaned

Small articles are cleaned in a cabinet



How the blast gum is used to clean large areas of metal



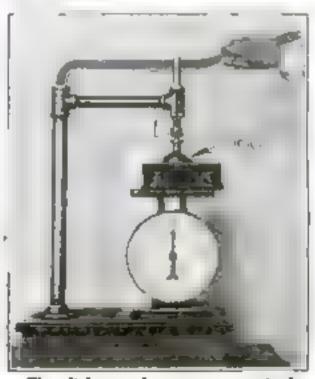
of sheet steel. Here the gun is stationary, and the sand hopper is placed under the chamber. The operator turns the work over and over in the blast stream until it is cleaned. Canvas sleeves protect his hands. He watches the work through a sight screen at the top of the box. The spent abrasive falls back into the sand hopper, and in this way the cleaning operation is continuous.

The outfit may be employed to clean paint from metal, finish off castings and stone work—in fact, wherever an abrasive is needed for a special job rather than for large standardized output.

Mechanical Tester Tells Ripeness of Fruit

TO DETERMINE Just when pears and apples should be harvested, Prof. W. S. Brown, of the Oregon Agricultural Station, pinches there with a scientific time?

The degree of ripeness is determined by the number of pounds pressure on the hand lever required to force the plunger into the pear or apple a predetermined distance. The invention is exceedingly accurate, and orchardists expect to save thousands of dollars, since its use insures that the fruit will reach the market in the best condition



The dial records pressure required to force a plunger into the poar

Largest Bulb Shed Light for This Photo



THE world's largest electric-light bulb, consuming one third of the power required to run an average trolley car, has been constructed for motion-picture studio work, by a concern in Cleveland, Ohio

Thirteen of these lamps have already been constructed for use in a picture studio in Schenectarly, N. Y. The light they produce is said to be the nearest approach to sublight yet armoved.

The monster lamp uses 30,000 watts

and produces 60,000 candispower—the equivalent of 2400 electric lamps of the size usually used in the home. It is 12 inches in diameter and 18 \(^1_2\) inches high and requires enough tangsten filament to supply 55,000 lamps of the 25-watt household warsety.

Measuring Work to Ten Thousandth of an Inch

A SUPER - MICROMETER, capable of making measurements to one tenthousandth of an inch, yet rugged and simple enough to be placed on any workman's bench, has been perfected by a New York concern. The machine consists of a rigid cylindrical bed, a dividing head and an adjustable foot stock. It has a range of eight inches between anvils and 8% inches between the anvils and table.

The screw has a working range of one half inch, indicated by graduations on a lorged ducalumin index wheel and on a measuring apandle. The work to be measured is placed upon the table between the anvils and the spindle is run quickly up to the work. A larger hand wheel for the final alow movement to contact is connected with a round belt that slips when a certain pressure upon the work has been reached. Thus in measuring several pieces of the same size the alopping will cause the same pressure to be exerted on all and the readings will be the same for al.



The super-micrometer, showing large adjustment wheel with slip-pulley regulator

Primitive Violin Built of Rainspout and Broom

STRANGE violins, with sounding boxes made of galvanized from spouting and fingerboards built of broom handles, will soon be on the market. After listening to the surprising music produced by such an instrument, an Eastern maker of musical instruments has began to manufacture them.

What Do You Want to Know?

OUR Information Department will gladly answer any specific questions on general or applied science. Address the Information Editor, Popular Science Monthly, 225 West 39th Street, New York City, inclosing mif-addressed stamped envelope.

Mechanical Harvest Hand for Hay Wagon

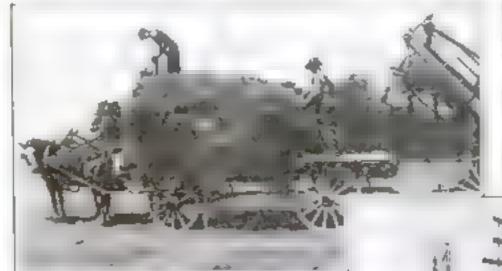
OBSERVING the effort expended by two men and a boy in pitching hay forward on the wagon after the bay dropped from a loader, an Obio farmer recently conceived the idea of a mechanical barvest hand to move the load forward on wheels, and thus save the labor of one man. He built a truck 6½ feet wide and 7½ feet long with four small wheels, adjusted to

run on a track formed by the two-by-fourinch side rails of a wagon rack

The truck is equipped with two long stakes and crossbars at the front end and short stakes with one crossbar at the rear end. Hay is loaded on the truck at the rear of the wagon. When filled, the truck is pushed to the front, and the remainder of the load is placed on the rear of the

wagon rack. This simple device makes it necessary to bandle the hoy only or "

To prevent the amail truck from rolling along its track during the loading, steel apring arms reach over and under the rack rada



At the right the ingenious loading truck is shown in position at the rear of the wagon rack ready to receive load of hay. When loaded the truck is rolled to the front of the wagon and the rear of the wagon rack race was the remainder of the load.



Artesian Wells Heat Boise Homes

THE present feel shortage holds few terrors for many of the residents of Bosse, Idaho, for they are supplied with natural heat from hot water artesian wells near the city. The wells, with a capacity of 1,500,000 gallons a day, supply enough water at 170° F., not only to meet the needs of a large natatorium, but in addition to heat hundreds of homes and office buildings in the vicinity of the wells.

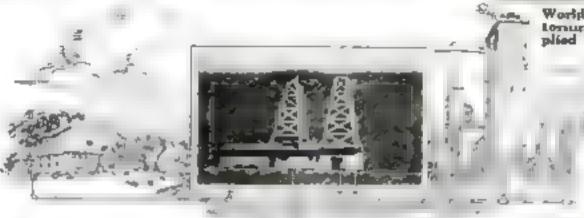
Two mx-inch weals originally were drilled to supply heated water for the pool. There was found to be a surplus, however, and pipe lines. were extended to the radiator systems of near-by homes. Two new eight-inch wells were druled and compressed air was fed Thin to the wells. caused serious oxidation and later the same percentage of flow was obtained by installing electrically driven turbine pumps.

This ingenious

heating system has demonstrated its usefulness, especially because of its cleaniness and economy, and it is probable that the fuel shortage will extend its development. A five-sixteenth-inch feed pipe, ordinarily the largest used, has a yearly rental of \$160. This supplies hot water for all hitchen, bath and heating purposes, as well as the free service of the heating company for cleaning, waste removal, and reasonable



World's second largest natatenum, at Boise, Idaho, supplied with hot water from artesian wells



How 1000 homes and office buildings in Boise are supplied with water at 170° F from arteuan wells. The central photograph shows the plant where the water is distributed by electric turbine pumps

repairs. The large pipe is used in office buildings, where the usual outlay for winter coal alone would be \$800, to which would have to be added the cost of furnace care, sah removal,

and damage to furnishings by soot. The amount of heat to be derived from the system depends on the cise of feed pipes and on the locality. A one-third-inch feed pipe under a 50-foot head of water will heat 20,000 cubic feet of space—sufficient heat for a five-room bungalow. Larger buildings use from one-quarter to one-half-inch pipe.

America's Longest Retarding Coal Conveyor Brakes Itself

troughs extensive downward from a louses on opposite slopes of deep valley to a central tappor fructure, are said to form the longest retarding conveyor. America

They are located near a coal made in Favette Counts.
W. Va., where the coal made its on two ridge coal. The feet allove the coal length of the Veyor is nearly had a mole.

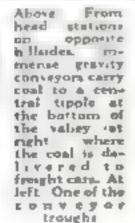
The conveyor is of the conveyor and button type, and uses I weight of coal for its operate. The buttons are metal disaspitacied to a cable that tune a was the base of the trong I by serve to retard the lumic a malit is dumped into the conveyor at the head bount. The weight of the coal thus retarded moves the conveyor cable by gravity downward to



the tipple at the buttom of the valley

In the downward recornect, the larger lumps being retarded by the buttons, the chick false etween the case and the edges of the trough bring and the friction thus produced serves as a brake to assist a proventing the conveyor from running away. In addit on, surplus power created by the we get of the coul is transferred to a shoft which is connected with a coul is desired and brake pulley device, the operation of which is auto-

to the head between coal is led to the conveyor at the rate of 10 tens an hour by a databating plate with prongs. Men stationed along the along of the conveyor pick out any impurities, such as slate, which they throw into chutes emptying on to the billiables.



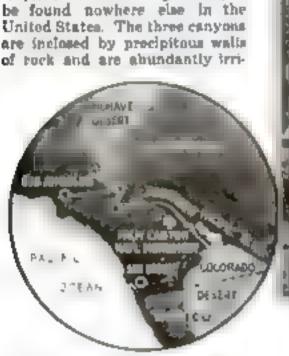


Desert Oasis Open to Public

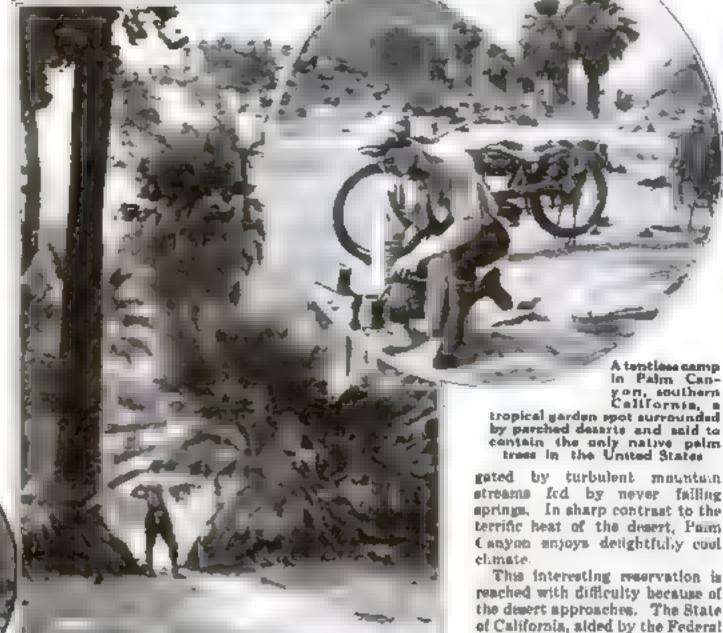
UXURIANT tropical vegetation, suggestive of the flore of an oasis in the Sahara Desert, may be seen in Palm Canyon, the newest of Uncle Sam's national monuments. This remarkable valley and its immediate surroundings within the reservation occupy an area of approximately 1600 acres near the northern and of the Colorado Desert in California, not far from the Mexican border.

56

To the mouth is the desert, to the east and west are wide stretches of desolute prairie alternating with rugged and barren mountain chains. In remarkable contrast to these surroundings, Palm Canyon and the other two canyons which it includes, contain a wealth of tropical and desert vegetation, to be found nowhere else in the United States. The three canyons. are inclosed by precipitous walis



This exceptional photograph shows the luxuriant vegetation in Falm Canyon (see map at left



streams fed by never failing aprings. In sharp contrast to the terrific heat of the desert, Parm Canyon anjoys delightfully coul This interesting reservation is

A tentiese camp in Palm Can-

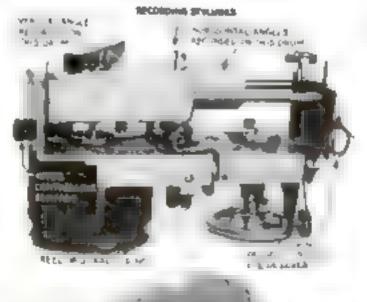
reached with difficulty because of the desert approaches. The State of California, aided by the Federal government, is now building an automobile road that will connect the reservation with roads of southern Caufornia

One Man Surveys Land with Automatic Charting Instrument

N AUTOMATIC charting instrument with which an explorer or surveyor can quickly make a fairly accurate map of any truct of land or river course, and which can be operated by one man, has been perfected by m French inventor.

The emential parts of the instrument include a compass, recorders for vertical and horizontal angles, controls for compass and recorders, and a surveying string.

The free end of the string is held by an assistant or may be attached to a tres. As the operator, holding the instrument, walks away from the attached end, and over the ground to be surveyed,



he moves a lever with his left hand in the direction of the twine, and with his right hand adjuste a knob that controls the movement of the compani. The movement of the lever determines the angular displacement in elevation. This movement is transmitted to an elevation recorder in which a stylus marks a record on a revolving drum

This curve, deciphered in relation to the distance covered by the operator determines the differences in elevation between two points. The movement of the company is similarly recorded on another rober and the combination of the two records gives a complete map of the territory covered. The instrument is held level and readings are with respect



Holding the charting mechanism shown above, and playing out a surveying string, the surveyor walks over the ground. The string measures distances, while the instrument records angles

charting instrument its case, with reel that holds measuring string



My Most Thrilling Parachute Jump By Master Sergt. Ralph W. Bottriell, U. S. Air Service







NE thrilling experience I shall never forget occurred when I made a parachute jump from 20,600 feet above McCook Field, Dayton, Ohm, with Master Sergeant Strong B. McDon as my pilot. I had just aignaled McDon that I was leaving the cockpit of the plane for the jump when part of my parachute harness caught on the gun turret, pulling the rip cord of my pack and releasing the parachute.

Quicker than I could think, the wind caught the chute. I was jerked out of the cockpit and whipped right through the rudder of the plene. The pull was so terrific that the impact broke the rudder

as I tore through it. The blow knocked me unconscious, and I dropped 5000 feet before I regained my senses.

Then I observed that one panel of the chute had been ripped by its contact with the rudder and I also realized that my left arm was numb. I thought at first that the arm was merely broken until I discovered that blood was streaming from my hand at such a rate that I would probably bleed to death before I landed, if it continued. So, biting the injured arm high above my head, I fastened the limp hand in the webbing of the chute. Three times my hand worked out of the webbing and dropped down, but each time I was able to lift it up again and

finally I fastened it above my head

With the wind rushing through the rest panel of the chute, I knew that my landing would be much harder than usual. I therefore pulled the jerk cord of my smergency parachute, which checked my drop, and I alighted in a field. There I was given first a.d. and later taken to the McCook Field hospital.

Meanwhile, McDan, who knew nothing of my abrupt departure from the plane until he attempted in vain to use his chattered rudder, maneuvered his disabled plane with meaterly skill, and succeeded in making a safe landing.

Pushbuttons Sort Parcels in This Remarkable Laundry

A SORTING machine invented by John R. Sousa, of Washington, D. C., to facilitate the work of distributing finished places in Laundries, is operated entirely by pushbuttons within reach of the man at the sorting table.

The device consists of several tiers of bins or compartments, each bin corresponding to a customer. Above each tier is a miniature railway along which a carriage runs. When the operator presses a button to have the load on the carriage dumped in that bin, a rake is raised by a magnet. This rake consists of several fingers that when raised protrude through the grillwork of the carriage and sweep off any bundle that may be on it

Every Carriage Has Its Motor

As the package is deposited in its compartment, an automatic latch reverses the motor and sends the carriage back to the sorting table. At the same time a cam returns the rake to its normal position.

Each carriage has its separate motor and double trolley that conducts the current for running the motor from the 12-volt storage battery

One of the machines now in use in a laundry at Washington has 50 bins arranged in four tiers with tracks and car-

By pressing push-buttons, each corresponding to a customer, the operator distributes parcels of faundry into individual compactments, as shown at let. The diagram of the ingen out sorting mechaniam, how shows rakes sweep parfrom carrier cesta big mage for each tier. This machine is con-

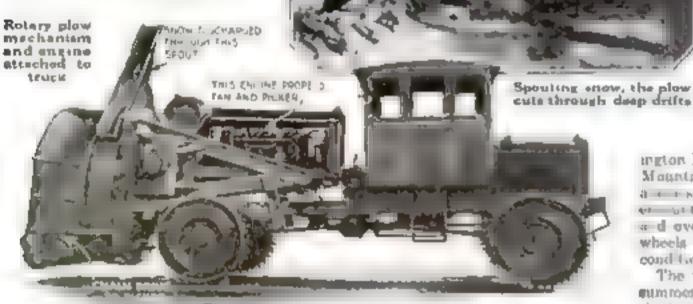
trage for each tier. This machine is controlled at a switchboard with eight rows of 10 pushbuttons each. Above each button is a rard with the customer's mark. Each car riage is controlled by two rows of buttons.

Rotary Plow Spouts Stream of Snow

QUIPPED with a spout that throws a stream of snow 200 feet to either side of the road, a new rotary snow plow that will clear a swath 6 & feet wide has been perfected by a Wasconsumoter manufacturer. It is reported to have met with extraordinary success in clearing away deep drifts on the steep roads of the Sierra Nevado Mountains.

Recolving Picks Break Up

The mow-digging mechanism consists of a fan and picker arrangement, mounted on the rear of a truck which, with rear and front drive wheels, can be driven backward over the road to be cleared. A horizontal shaft, to which are attached 30 pickers, is rotated by a motor located just behind the driver's cab. The revolving picks break up the compact, frozen snow ahead of the truck and permit the







The "business" end of the truckplow, showing picks mounted on rotatable shalt to break up packed anow, and behind them a vertical fan to blow the enow through discharging spout

advance of the machine into the broken-up material.

A vertical fan immediately behind the picks blows up this material into a chute leading to a spout pointing diagonally upward, which can be tilted to right or left, according to the side of the road on which the snow is to be deposited. From this chute the snow shoots diagonally upward like a high pressure stream at a velocity that carries it 200 feet beyond the side of the road.

During tests conducted at Huntington Lake, near Freeno in the Sierra Nevada Mountains of California, about 10,000 feet a sea level, the most severe conditions were expected, grades of 30 per cent being met a dioversome. Under such conditions picket wheels were required, although for ordinary conditions chains are used.

The machine is so constructed that, in the summer, the snow plow can be removed and the truck used for banking.

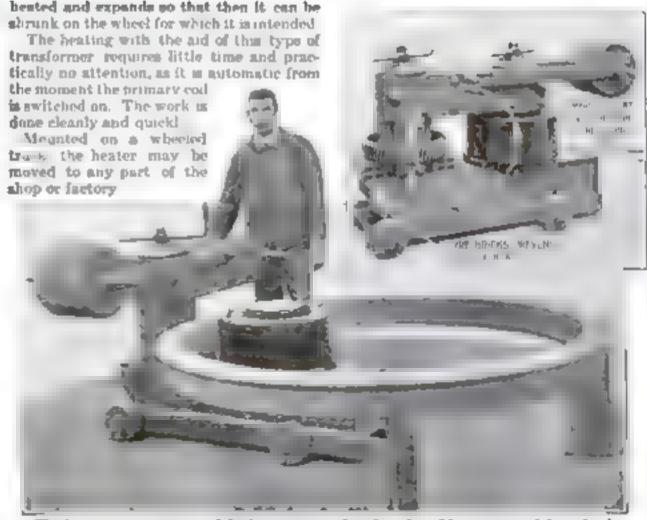
Electric Current Heats Metal Tires and Gears Automatically

preparatory to shrinking them on whoels, is now accomplished automatically by means of an induced electric current passing through them, in an ingenious apparatus perfected by a Swiss manufacturing concern. This apparatus, designed on the principle of an electric transformer, has three isminated iron cores—two vertical and one horizontal—and a primary coll, with adjustable wiring, placed around one of the upright cores.

Gear Ring Placed around Core

The long horizontal core surmounting the apparatus may be pivoted to either of the two vertical cores, an arrangement that is necessary to permit of the tires or gear rings being placed around the free vertical core. A counterweight is hanged to the horizontal core and may be awang to either side to counterbalance the unsupported end of the core.

The ring or tire to be heated may be placed around either one of the vertical cores and is supported by heat insulators. The electric current passing through the primary coll of the transformer induces a secondary current in the metal ring or tire around the other core. Being connected with itself, the metal of the ring, short-circulting the induced current, becomes



The heating apparatus, with circuit open, showing tire of locomotive drive wheel in position. Inset shows gear ring being heated by induced current

Navy Builds America's First Rigid Airship to Prove Commercial Possibilities of Huge Airliners

Undaunted by recent disasters, Uncle Sam is going ahead with "ZR-1," as the forerunner of giant dirigibles that will cruise 5000 miles with 400 passengers

By Ernest Jones

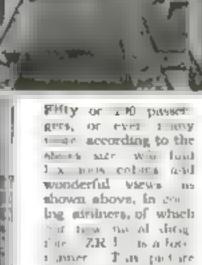
NDISCOURAGED I the fate of the "Zit built for the in high land, and wrecked in Aug ... Still a state to this terms taken terred by the firm are as f the negri-rigid born bus for up in Italy and completery wrecked a what was the nye been a short truel true ever as g y Field, ha e In tec States navy is quieta. going shead with the but ing of enormous how rigid airsh ps, capable of carry og scores of passengers on long distance llights

Three New Diregibles

The general recent dasbeen that the and recent dassaters, including that to the C.J. B. Nac. As meant the end of analog building, and that the future of air travel lay in the use of junces, rather than gus filed bags. Yet now the bags frame of the Zite the first raid quality exist enstrained in Anne and raid toward computers at Lakes burst N. J.

Meanwhile, construction of the 'ZRI' a construction of a parely converse of type,

Rejon the international mandard i see one and for authors, with passensels are not enturisation stage. I want is tracked at Lakehurst, N. 1. The huge rigid sirliner, to be built for our government in Germany, will un doubtedly make its first American flights with passengers from this "aerial dock."



of the profiles managers.

is from enumeers as

t my jenn o

term ary the science of terms of the science of the science of termin gas, as one or or already and and that ly, at Lakehurst and at Relieville, Ill., are being completed already hangars of tremendous size. Moreover, the world's tallest number great of unique design, constructed without guy wires, and containing an elevator to care passengers to the empress.

Why the Navy Believes in Commercial Airships

A DMIRAL WILLIAM A. MOFFETT, Chief of the United
States Bureau of Naval Aeronautics,
explaining, in an exclusive statement
to Portulan Science Monthly the
navy's purpose in doggedly developing
the rigid arising, in the face of three
recent disasters, lends weight to the belief that
Zeppelin type, passenger-entrying airline's,
tendered safe by the use of helium gas, are to be
a real type the use of helium gas, are to be
a real type the use of helium gas, are to be

After the war the General Bland of the Navy recommended that we go should with two ngues the ZR I here, and the ZR I, due to the from Germany.

By keeping accurate core data we felt that we could determine the commercial utility of great airships. The 'ZR 1,' when finished, will make trips across the continent, to show the practicability of rigids for commercial use.

"Development of the maoring must, since

the war, making it possible to anchor the rigid for weeks at a time without damage, and insuring safe embarkation for passengers, addagreatly to the commercial future of these air ships. The masts can be erected for \$20,000 or \$30,000, including passenger elevators. They can be placed in cities, or any other place where needed, and are economical substitutes for the huge sheds costing over \$1,000,000

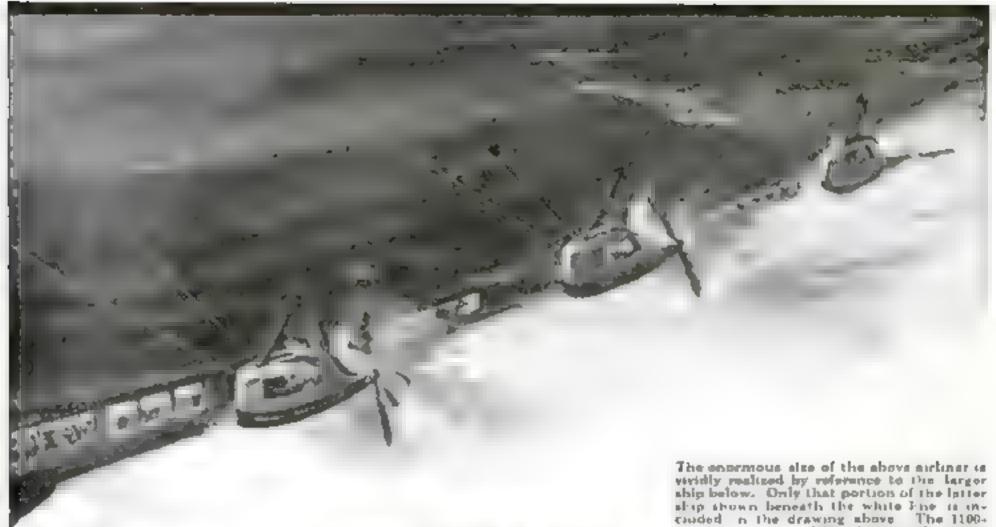
We believe strongly that rigid airships may be of great commercial value. Cor pare them with the valuearls. They do not use trac a roadbe is way stations or any of the related paraphersaha nor do they require personnel for maintenance of way. Power plant and Pull it an combined they have the free heavens for

"If the Uni ed States did not go shead with the 'ZR-1' and the 'ZR 3,' world progress in serial transportation would be set back one or two generations,'

Admiral
William
A
Molfett

Chief
of t S
Bureau
of Naval
Aeronautics





1100 FT

10,000,000 CU FT GAS CAPACITY

use American durasumte in its One of the construction largest rigid airships over completed, it will have a content of 2,115,174 cubic feet of gas, a length of 680 feet, a height of 98 feet, and a diameter of 78.6 feet. In seven cars hanging from the great keel of the vessel will be located the navigation, radio, and propelling mechanisms. Six of the care will contain Packard airably engines of

300 horsepower, capable of 1400 revolutions a minute. The 20 bags, to be filled with nither helium at hydrogen gas, will be of cotton lined with goldbeaters' skin, for which the skins from 500,000 head of

eattle will be utilized

680 FT Engineers' figures

show that a ship less than twice as long as the "ZR I" gram) would in-dresse its lifting especity \$ times



With a framework of dumiumin — a composition

largely consisting of aluminum—the "ZR-I" will be manned by a crew of 21 and will be espable of lifting 40 tons, besides her own structural weight of 30 tons. The airship will be able to travel 9000 miles without replevishing ber fuel. She will

ship shown beneath the white I've is in-

foot ship would carry 400 passengers on a cruise of 5000 miles, together with baggage and multi while the "ZR-1" would carry only 50 passengers

have a crutaing speed of 50 ralies an hour, and a top speed of 75 miles an hour

The Lakehurst shed, specially built to house the "2R-1." wall be the largest in the world -so vast, in fact, that two United States Treasury Build-

ings could be placed one on top of the other under its roof, and the flagstaff of the second would not touch the ceiling. Again, if the Tressury Building were placed at one end of the shed, there would still be room for a basebuil diamond. The shed will house two larger ships than the "ZR-1"

In the "ZR-3," to be constructed for Uncle

Rigid Airship Commercially Practical, Says Zeppelin Expert

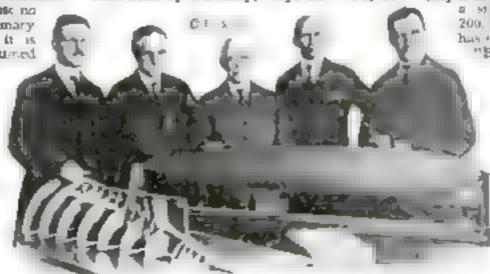
THE right airchip is at this moment a practical means for air service between America and Europe, offering passengers about the same conveniences as a Pullman train at an expense no

greater than that on an ordinary steamer —perhaps less, when it is considered that the time consumed

in a voyage is cut in half. There is a commercial need for the airship that the air plane does not fill there are rewards for those who recognize and meet thus demand "

Such is the statement given exclusively for Popu-LAR SCIENCE MONTHLY readers by Dr. Max Munk, former aerodynamic expert of the Zeppelin Company, and now employed by the U S. National Advisory Committee on Aeronautica as technical assistant to the committee of experts that is studying the design of the "ZR i " Doctor Munk is probably in closer touch with the actual achievements of rigid airships than any other man in America.

"More than 100 practical rigid shaps have been built by Germany," says he. "Yet we



Committee of America's forement aeronautic engineers studying model of the dirigible "ZR-1." They report their findings to the National Advisory Committee on Agronautics. Left to right: W. Wetters Pagon, Bultimore, Md., Dr. L. B. Tuckerman, U. S. Bureau of Standards; Henry Goldmark, chairman, New York City, Professor William Hovgaard, Boston, Mass., and Dr. Mar Munk. technical assistant, formerly of the Zeppalin Company

are only at the beginning of airship development. The larger the ship becomes. the more economical it is. Safety probably is as great as with a steamship. Not

a single passenger of more than 200. 900 carried by Zeppelin strabips has ever been injured.

"Besides carrying greater loads than the sirplane, the airship can remain much longer in the air.

"The size of rigids during the war was finited by the sheds to which they were constructed and boused

"The structural problems are merely problems for the engineer An airship, like a house or bridge, if properly designed and manufactured, is strong enough to fulfil the purpose to which it is put-

"The fire hazard is negligible. No German atrahip was ever burned in the air save by enemy action. One ship was even struck by lightning and no unjury resulted

Sam by Germany under the Reparations Agreement, may be expected the real development of the airship for commercial use. While its completion is not so immediate as that of the "ZR-1," the Navy Department has announced that the "ZR-3" "will be of the purely commercial type, and that it will be used on an experimental passenger line." This—the first of America's future passenger arriners—will represent the last word in foreign airship construction, and representatives of this country have already left for Germany, to "sit in" on its construction.

Great Chance for Development

How swift may be the development of subsequent airliners, capable of transporting large numbers of passengers, with baggage, is indicated by the fact that every increase in size means a proportional greater increase in speed and lifting power. In fact, dirigible designers declare that doubling the length of an airship increases its lifting power more than eight timest. This means that while the 680foot "ZR-1" as a liner could carry 50 passengers, a ship only twice as long could carry

400 passongers. The crucial test for commercial airships of this type, of course, will be action by bankers and business men, who will be called upon to put their money into them. In the connection, it is significant that a commercial airchip company is already planning to acquire three aimhips, such twice the sise of the "J-1." Inquiries from this and other organizations of business men concerning the immediate commercial possibilities of the airabsp, recently led to an extended investigation by engineers, followed by a definite plan for putting into commercial service at least one of these new giants of the air. One of the leaders in this enterprise has been Fred S. Harresty, Washington representative of the General Electric Company, who is associated with a number of nationally known men in the formation of a great system of archip soutes.

'Commercial air navigation is no longer a subject for speculation," Mr. Hardesty told me. "It is a present practiculity. The luxury, economy, safety, and volume of simble transportation in Germany before and after the war are startling, when one is confronted with actual facts regarding the enterprise

'America, with her far-flung territories and insular possessions, with her commercial possess it is central and South America, and with her centers of population demanding more rapid transportation, is nature's chosen spot for civil sirship navigation. Another year should see transcontinental sirship routes under way, if not in actual operation."

Major-General Mason M Patrick, Chief of the United States Army Air Service, explaining the development of the rigid airship in the face of difficulty and minhap, offered this statement:

What the Future Holds

"We foresee dirigible airship transportation—civil and military—immediately. We feel that we already have the knowledge and experience to produce equipment. We see clearly enough ahead to warrant in in exerting every possible effort in airship construction, taking advantage of what we already know. New possibilities and new uses for lighter-than-air craft will be determined, and new equipment will come as a matter of course."

Further revelations of the farseeing plans of the United States navy and army, showing the way toward commercial use of the archip, are contained in statements, ac-



World's Largest Airship Hangar to House "ZR-1"

THIS remarkable photograph of the vart shed at Lakeburst, N. J., built especially for the "ZR-1," shows a section of the hage ship's frame rising on the immense cradic constructed for it.

So specious is this hanger that two buildings the size of the United States Treasury could be placed, one above the other, within its walls, without touching the ceiling!

companying this article, by Dr. Max Munk, onetime aerodynamic expert of the Zeppelin Company, and now of the United States National Advisory Committee for Aeronautics, and by Admiral William A. Moffett, of the United States navy

As evidence that the entire world is alive to the immediate possibilities of commercial air travel by means of the rigid auship, an international conference, at which the United States was represented, was held this year in London. The purpose of the meeting was to standardise the fittings and docking gignals for airships. masts, it was decided, are to be fitted with standardized "wharf" tops, to receive the conical bow of any airship of any country. Gasoline and gas lines are to be of uniform size for refueling. Other items, such as pulley blocks for hauling airships downward, and signal lights, will be standardused. Furthermore, a Spanish company has announced immediate establishment of a transatlantic airship service from Seville to Buenos Aires.

Answering the aweeping criticisms of

dirigibles as a class, aroused by the wreck of the "C-2" and the appailing loss of life in the disaster to the "ZR-2" in England and to the "Roma" in the United States, the Bureau of Aeronautics of the Navy De-

Pioneering Incoloes Risks

partment has this to say:

"The Bureau thoroughly appreciates the fact that it is essential to insure safety of operation in handling rigid and semi-rigid airabips, but it is strongly of the opinion that the construction of the 'ZR-1' should be proceeded with, in order that a proper development of the lighter-than-air art may go hand in band with the development of beaver-than-sir art. Pioneering in any art involves the expenditure of brains and a certain amount of risk."

Soon after the completion of the "ZR-1" we may expect the possibility of traveling by sirship safely, at a speed greater than we have ever known, with much more comfort, and with far more economy of time and expense.

Building Stone Tested in Government "Ice Chest"

TITHOUT an annual coat of waterproof white paint the White House at Washington would have crumbled to a mass of ruins at the end of 100 years!

Unprotected from extremes of weather in the District of Columbia, the Virginia sandstone of which our Pres dent's home and the original part of our national Capitol are constructed would quickly break down after 30 ог 40 уважь.

Startling facts concerning the effect of

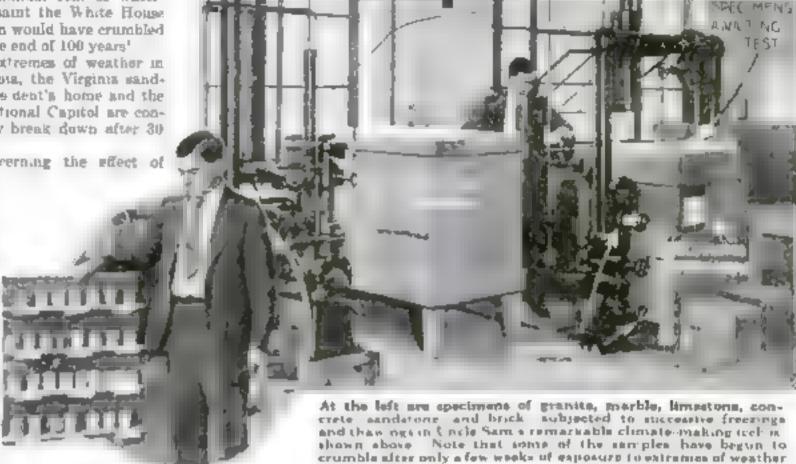
climate and temperature on building materials, have recently been revealed by tests conducted in a remarkable (cebox devised by Dr. D. M. Kessier of the United States Bureau of Standards in an attempt to standardize building apscifications for the various sections of the country. and to minimize present rinks in construction. In a few weeks' time, this extraordinary refrigerator re-

produces all the climatic variations that would be encountered in any given locality

during a period of 25 years.

The fact that a material that wears exceptionally well in one climate may deteriorate in another has long been recognized. Cleopatra's Needle, the famous Egyptian obelisk now standing in Central Park, New York, withstood centuries of Egyptian weather, yet began to deteriorate as soon as it was brought to this country

The causes of rock deterioration are interestingly revealed by the tests. When rock is relatively dry, it is not greatly damaged by exposure to freezing. But when it is watersonked, as by continued



rains, the pores of the material are full of water that expands as it freezes. This expansion strains and breaks the material

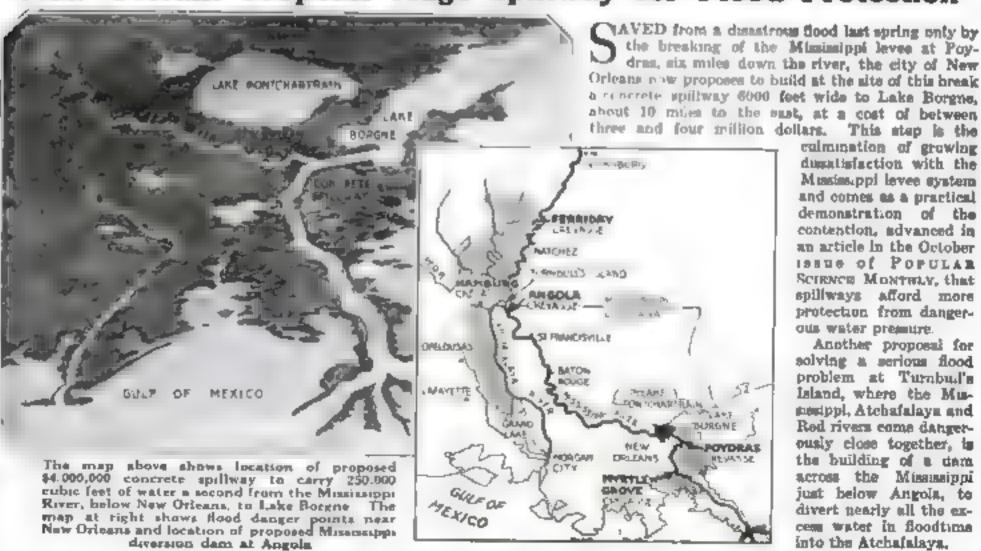
Ammonia Cools Test Tanks

The ice chest comusts of three abcet-iron tanks, one inside the other, and all insulated by a wooden covering with cork lining. Specimens of stone to be tested are placed on trays in the inner tank. Cods of pipe surrounding the tank conduct ammonia for cooling the tanks.

Alternate periods of freezing and thawing inside the chamber are governed by a Two drip simple pail-tilting scheme.

huckets are bung on the ends of a balanced beam. These ends are connected with valves, one of which controls the flow from a water supply, the other controlling the flow of ammonia into the cooling apparatus. When the buckets are in one position-one up and the other down-the ammoria valve is open and the test chamber is subjected to freezing conditions. When the position of the buckets is reversed, the water valve is open and water fills the chamber, subjecting the specimens to raining and thawing conditions. By regulating the drip from the lowered bucket, experimenters can regulate the length of a treesing, thuwing, or raining period

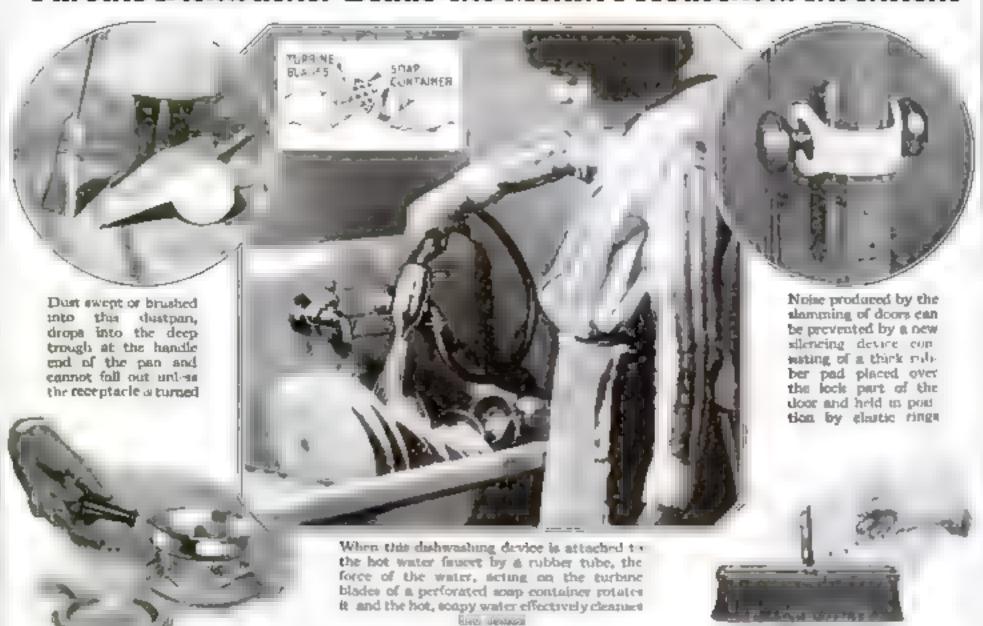
New Orleans Proposes Huge Spillway for Flood Protection



colmination of growing duratisfaction with the Musissippi levee system and comes as a practical demonstration of the contention, advanced in an article in the October ISSUE OF POPULAR SCIENCE MONTHLY, that spillways afford more protection from dangerous water premure.

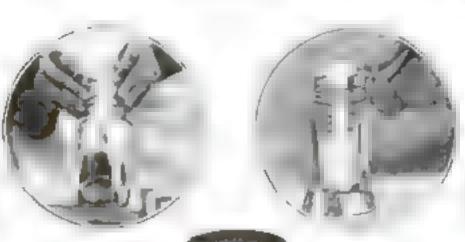
Another proposal for poolving a serious flood problem at Turnbulls Island, where the Mumesippi, Atchafalaya and Red rivers come dangerously close together, is the building of a dam across the Mississippi just below Angola, to divert nearly all the excess water in floodtime into the Atchafalava.

Turbine Dishwasher Leads the Month's Household Inventions



Designed for the bachelor who likes to prepare an occasional cup of coffee, this new device consists of a strainer with exchangeable alk cloth which holds the coffee while hot water is poured over it

To prevent the slipping of a jar while a tight lid is being unsertwed, the jar may be fastened in a specially designed vise clamped to the table



Refined petroleum poured into the reservoir of this broom ours through fine openings in the bottom of the reservoir and moistens the bristles, causing them to hold the dust removed from floors or carpets

Turning a thumberrew in the top of the slacker shown at left revolves small knives that scrape the crust of salt obstructing the holes maide the shaker cap



The drying cabinet shown above will dry laundered clothes from the wringer in about 30 minutes. The cabinet is heated by gas and combustion is so complete that a fine connection is unnecessary



Material of silk or other fine thous to be pleated is laid over this pleater and pushed everly into spaces between the grating with a aliver laide. Then a hot from is run over the material



The cotary ash receiver shown above consists of a rotatable framework holding a number of cases in a pit below the ash compartment of the furnace. The full cases are removed through an opening in the pit

Statues of Concrete and Woven Wire

How remarkable sculptor molds cement and sand

CONSTRUCTION of hollow concrete statuary, in which a plastic mixture of cement and sand is molded upon a framework of piping and woven wire, is a new departure in the art of sculpturing devised by T A. Brouwer, of Pinewold Park, Westhampton, L. I.

The sculptor first constructs a base framework of galvanized from pipe and upon this fasters quarter-inch galvanized from wire mesh to conform to the general contour of the statue. Upon this wire he packs his concrete and molds the figure from the bottom up so that it will be able to carry its own weight while the concrete is hardening.

The average thickness of the finished shell is one inch and it is very hard after cetting, the concrete musture being made of 134 parts sand to one part coment. Various finances are obtained by adding coloring ma-

terial to the cement.

This new method of modeling in concrete opens a wider field for architectural adornment of buildings, since it is light and durable, and can he carried mustly to any height demanded by the Work in hand.





MOLDED of concrete on a framework of waven wire and parang this remarkable statue trpa seat and a noldier planting the American flag in France, was recently completed by T. A Brouwer at Eastport, L. I. The pedental in part of a globe 15 feet in diameter formed of centat tenforced by wire supported on fron piping. The figure is life size, while the fing eers at the left before application of the concrete, is eight feet high

Straw Houses in Devastated France

STRAW houses, warm, comfortable, and waterproof, are making their appearpage in the devastated regions in France, as the result of the high cost of other building muterials. They are constructed at about half the cost of the usual frame houses. Straw of any kind to cut into small bits with revolving knives, crushed on steel roders, and then compressed by beavy hydraulic presses into blocks about 18 inches square

manner. To prevent the straw blocks from absorbing water from the ground, a layer or more of tar paper is placed between the foundation and the first layer of blocks.

The straw walls are coated with stucco, plaster, or plain whitewash on the inside and the outside to protect them from the weather and to improve their appearance. Yests show that three straw blocks are an excellent insulation against heat and cold.

The fram ng of a at price to be to be to the which carries all the stresses is put up in se to he as rwn as the se t. en e the compressed straw pricks are used as fil a trevalua d gardet are and are fitted in betramework as below in cross section, and of any desired length. The blocks look like very coarse, compact ardbeard. Since the weight of the straw blocks is only one tenth that of brick or stone, the houses do not require heavy foundations. A tight framework of studs is erected, and blocks of compressed straw are used to fill the spaces between the beams. Door and Window frames are provided in the usual

ID you know that annually in the United States 83,000 dwellings are burned with 15,000 lives lost? Read in next month's issue, how you can make YOUR home fireproof.



Electricity Drives Pneumatic Tool

AN EXTRAORDItool recently developed C COURTED energies, operated by an eccentric deriving is power through a flexible shuft

The sample construction of the tool is shown in the diagram. It is manufactured in six different sizes, varying from a delicate tool for engraving, metal chasing and light hammering, to a heavy tool for metal chipping, rock drilling or riveting.

On the down stroke, the piston, connected by a ball foint with an occuntric rod, compresses the sir in the cylinder and drives the reciprocating hammer downward against the shaft of the tool. On the return stroke, the suction of the piaton draws back the hammer, but the air in the cylinder forms a cushion between the tool and the piston. The hammer is capable of delivering from 1800 to 5000 blows a minute.

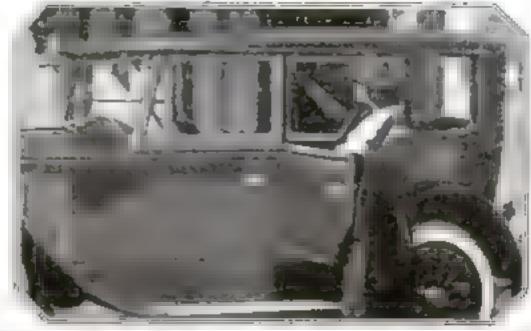


Quick Change Auto Top-Other Useful New Accessories



The erom chains of this anti-skid auto-chain are removable. Each link of the side chains has a flat side, over which the end hooks of the cross chains can be slipped.

Automobile tires
can be quickly removed with a new
tool consisting of an iron ber
and a pivoted book, shaped
like a horseshoe, which is placed
around the tire



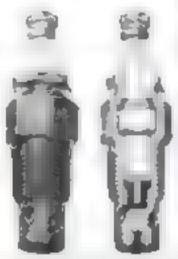
Shiding glass panels, suspended from tracks, move to the cear of this new auto top, converting the closed car into an open car. The panels are freed by a lever

The fender bar shown below serves as an automobile lock when horns at ends of the bar are turned upward and locked, making it impossible to steer the car



Mounted on the dash entirely independent of floorboards and motor, a new foot accelerator for Fords (at left) cannot become jammed in floorboards or mat

Used with any garden hose, the mechanical automobile washer tot right: has a revolving brush driven by water power at from 300 to 400 revolutions a minute



Inclosed in the base of this new type of spark plug is a small ball, the oscillations of which at every explosion prevent the accumulation of carbon in the plug

This ingenious headlight control switch, placed discretily under the steering wheel within easy reach, permits the driver to regulate his lights without removing his

hands from the wheel



Bombproof Shelters Save Lives in Powder Crushing Mills

Loss of life from explosions in the dangerous econing or powder crushing mills of black powder plants has been largely eliminated in the plants of the E. I. Du Pont de Nemours & Company by the construction of bombproof

shelters in which workmen operate the mile from a safe dutance.

Controlled by Levers

In the corning mill. cakes of pressed powder are crushed into granular form by passing between pairs of metal rolls in the corning mill. The workman charges the mill with powder and then goes to the shelter, 50 yards from the mill. The shelter is equipped with levers with which he starts and stops the operated electrically machinery. Through a small aperture the operator watches the machinery of the corning mill. The mill itself has an electrical mechanism that automatically stops the mill if any foreign substance finds its way to the rollers. The shelter house is about six feet square, all

parts being constructed at least six inches in thickness.

These two safety devices have succeeded

Three two safety devices have succeeded in eliminating tom of life in nine coming mill explosions that have occurred at various powder plants since their installation



In a hombproof shelter at a safe distance from the corning mill, the operator controls with levers the electrically driven powder crushing machinery

Bean Pests Spreading

AS WAS predicted in POPULAR SCIENCE MONTHLY last April, Mexican bean beetles are causing increasingly beavy damage to our bean crops.

Reports of the United States Department of Agriculture say that the beetle has infested 24 new count.es in Georgia, Kentucky, Tennessee, North Carolina, and South Carolina.

Will Oil Replace Coal in Our Furnaces?

Here Are the First Accurate Facts Showing Advantages and Disadvantages of Converting the Dirty and Costly Coal Furnaces in Our Homes into Oil Burners Such as Are Now Heating Skyscrapers

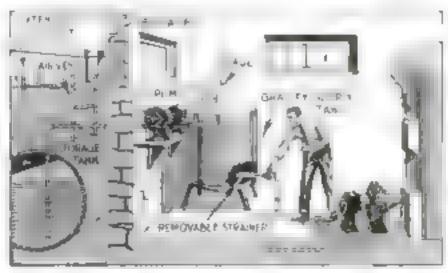
By F. A. Platte

THAT are the chances of a neat, economical oil-burning furnace replacing in our basements, for heating purposes, the dirty coal burners we

use today? Alluring pictures of a revolution in home heating methods, following the development of economical oil-burning installstions, have been presented to us in recent months, and have caught the public eye all the more vividly because of the coal crists. We know that ships are being rapidly converted from coal to oil burners, and that many great office buildings have adopted oil burn-

ing installations this present year.

Will our homes be the next? The fact that several hundred oil burners now on the market are being advertised as suitable for installation in domestic furnaces emphasizes this question in every mind. Yet it is estimated that much less



A typical installation of an oil burning heating sys-tem for the home is shown above. The equipment includes oil storage tank, gravity supply tank, pump and automatic heater installed through the ask door of the ordinary coel furnace

than I per cent of the homes in the nation have so far adopted this new method of heating. It is the purpose of this article to give interested home owners the first accurate picture of the actual advantages

and desdventages of conversion from coal to oil burning in the

That oil, if used in a proper apparatus, will produce more heat to the dollar of cost than coal, is the claim made by oil men and conceded by engineers. In the present types of small oil burners efficiencies of 50 per cent have been obtained, whereas coal burners are rurely more than 25 per cent efficient when fired by the layman. Taking present prices of oil and coal, it is safe to say that a home requiring 10 tone of roal a winter would be heated by oil at a cost of \$20 less than the coal would cost. For other homes the saving would vary, in proportion to the number of tons of cost permally used.

This saving appears to be offset, however, by the initial expense of installation of an oil burner. Although the same coal furnace is used, yet from \$250 to \$600 must be expended, at present, for the hurner,

Advantages of Oil Heating and What It Will Cost You

By W. C. McTarnahan, Vice-President, Petroleum Heat and Power Company

FOU have, no doubt, been wondering recently whether burning oil in your furnace, instead of coal. would have advantages in the home similar to those proved for it in big

buildings and ships. Without studying the engineering problems, you can appreciate the anparent advantages of oil burning. namely: that heat can be obtained at a lower price, that oil can be handled more easily than coal, that it means a cleaner furnace

In the great Metropolium Tower, New York City, Mr. McTarnahan inset has just installed on oil burning heating system

room, that it clim inates ashes, and requires sens ator

Age apoce These facts have been among the reasons prompting oil burning installation in some of the largest husldings and department stores in the country. In New York alone, the great Metropolitan Tower, the Ritz Carlton Hotel, John Wansmaker's, Mount Sinai Hospital, Columbia University R H Macy s department store and many other hotels and buildings have just adopted oil burning systems. Throughout the country, numerous other installations are even now being made. But up to the present time there has not been a parallel development in the use

of oil in our homes. Naturally, the oil burning engineer has given his first efforts to important buildings, and here has proved the success of the new Recently system however, residence oil burners have been de veloped. They offer you the opportunity of successfully burning oil in the same furnace in which you are now

Our Oil Supply

mang coal.

Some home owners bentate to adopt the new system through fear that oil may be hoarded, and a higher price demanded later on Amoment I thought will show that thus in impossible. The annual produc tion of fuel oil to al ready enormous. The annual supply is like a continually rising

river, which cannot be damined. Since it cannot be stored, it must be marketed, and at

a price to compete with coal.

In certain localities, coal may temporarily be cheaper than fuel tal, but this condition cannot become general, by reason of the large quantities of fuel oil that must continue to be thrown on the market. Those who are today burning oil are doing so because it saves them The fact is that fuel oil is a direct competitor of coal, and it cannot be bester-

in competition. Producers of fuel oil are in a position, because of the lower costs of production, to undersell the coal producer all along the line.

But what about the permanency of the

fuel oil supply?

To answer this question, we must go back to the potential supply of oil throughout not only the United States and Mexico, but the world. Petroleum is to be found all over the world, except in Australia. From Alaska, in the North, there is a string of all wells down to the southwest tip of the American continent. At least a dozen states have given their names to big oil fields in this country, while there are great oil possibiblion in 35 foreign lands. Just one of these foreign countries, Russia, tressures more oil to one comparatively small area than there is in the whole United States. And the United States' production in 1921 alone, was 475,000,000 barrels more than half the world output. Geotogista claim vast oil fields in South America are as rich as the Russian fields,

Surveying these facts, the house owner who contemplates changing from coal to oil need not fear that the oil supply may run out or that the price of où may become prohibitive.

But how much will oil fuel cost him

It is generally recognized that under normal conditions 125 gallons of oil wall produce about the same amount of attack able heat as a ton of coal, depending upon the make and size of burner With gas oil at the present price of 8 cents a gallon, the relative expenditures would be \$12 for oil and \$14 for coal. Should the relation of prices remain unchanged. a saving of at least two dollars for every on of coal now used would be effected, and it is entirely probable that the same or a better ratio will be maintained for some years to come.

oil tank, and installation. In some places where city ordinances are extremely severe, the cost may run as high as \$1000. So, considering fuel saving only, it would apparently take considerable time for an oil burner to pay for itself.

Possibilities of the Future

There is good reason to hope, however, that increased public use and refinements in design and manufacturing costs will ultimately lower considerably the first cost of some of these appliances. Simple in operation, in improved types, easy to care for, quickly turned on and off, so that the fire is burning only when needed, the new system is so similar in its advantages to other household utilities, as electric light, that it seems almost certainly in line for

widespread adoption.

A Western manufacturer of a new oil burney that is said to be unusually simple and efficient, makes the point that the system will appeal to individual owners of innumerable small establishments, like laundries, greenhouses, and hotels. With this system, it is commed, the owner of a greenhouse, for example, can pay for his oil burner in less than a year from his savings in the cost of fuel, and still be ahead at the end of the season. Much of thus saving is said to be due to the fact that the new oil burning equipment has eliminated expensive mechanical devices such as electrie motors, pumps, and oil compressors that heretofore have been used for atomixing the oil and that have been largely responsible for the high cost of installation.

It is quite possible that such installations will be the intervening step between the present use of oil fuel in hig buildings and its uitimate use in homes.

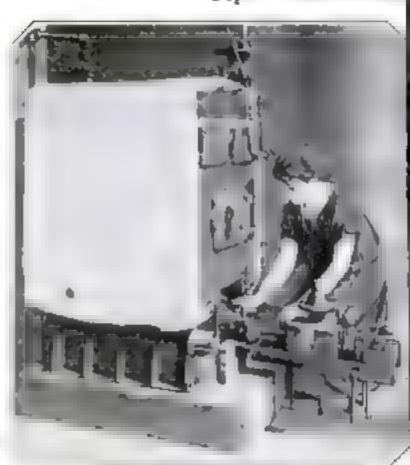
"Gas Oil" Used in Burners

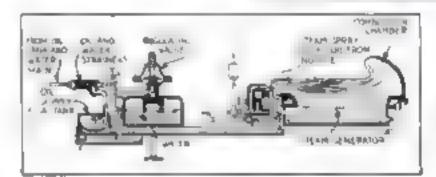
The oil that is used in the so-called gas oil, a by-product constituting about six per cent of the products obtained from crude petroleum. At its present price of about 3 cents a gallon, it can be purchased wherever Standard Oil products are sold.

As to the burners themselves, there are

three chief types, each of which is designed for the same end—to achieve a maximum burning surface for the oil. Each attempts to break the oil into minute droplets—to atomize and mix it with a sufficient quantity of air, so that complete combistion will be obtained in a short time.

The first of these types uses a blower, operated by a small electric motor. A jet of air, rushing past the opening of a pipe containing the oil, sucks out the oll and unites with it. The great velocity of the air, and the fact that its quantity is very great in proportion to the quantity of oil that can escape, causes a mixture in which the oil is broken up into very minute particles, thereby bringing the combustible oil in close conjunction with a large quantity of oxygen. The





Steam Blower Type

In this type of oil burner a steam apray causes the flow of oil to the combustion chamber and atomizes the oil. Steam is generated in a flash boiler below the oil flame, as shown in diagram at left

ignition is generally procured by a small priot gas flame.

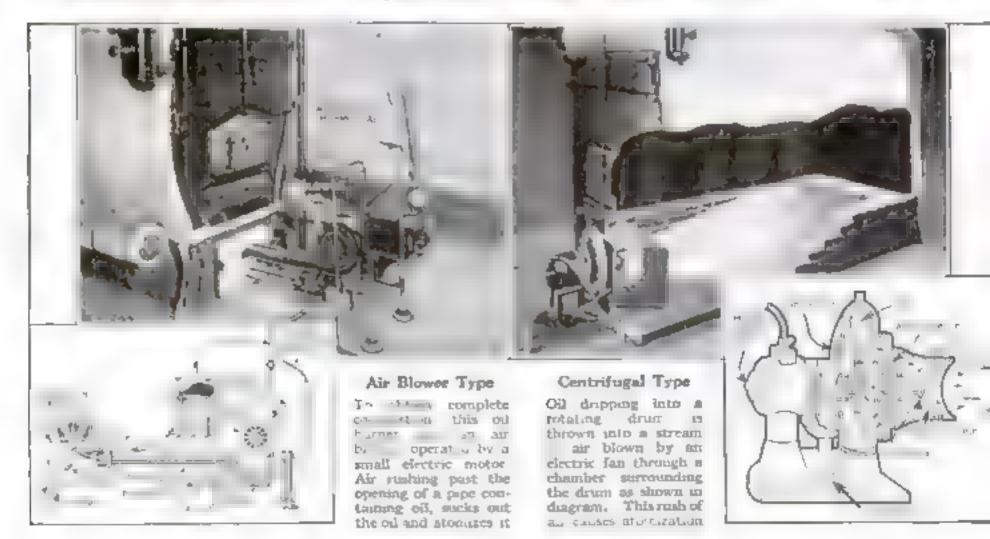
Another type uses steam as a vehicle for carrying the oil and atomizing it. An illuminating gas flame is used to heat the water in a flash boiler, until steam is procured. After a few minutes the steam starts to atomize the oil, as in the case of the blower type, and thereafter the burner is self operating, producing the steam by means of the oil flame.

The third type, utilizing the principle of centrifugal force, consists of a rotating drum upon which oil is allowed to drip. The oil is thrown out from the center into the path of a stream of air that rushes out

through an annular opening surround, notice drum. The rush of air picks up three oil particles, and, completing the atomization, produces the properly refined dominantible mixture.

Will Oil Become Home Fuel?

Whether or not oil is the fuel of the future for the home can be answered only be time. The burners are still in the Rode Royce rather than the filver class. I they can be made foolproof and chespet and if the cost of oil remains low, it is the expected, that their use will become widespread.



Jack Binns' Ten Commandments for the Radio Fan

Third Series: How to Get the Best Results with a Regenerative Receiving Set—Simple Hook-Ups and How to Make Them

THE regenerative radio receiving circuit was born to the world in 1912, out of the genus of E. H. Armstrong. To its proud parent it was a perfect angel in disposition and behavior, but now, at the age of eleven years, it still equeals and howls in the hands of the novice, unless handled with the utmost care.

To help the novice avoid these dis-

turbances, it is my purpose, this month, to lay down 10 important rules, based on the experience of those who for years past have nightly walked the floor with Miss Regenerative Receiver, and have learned by bitter experience just how to humor her so that she will act as a perfect lady of radio ahould. Heed, therefore, the Ten Commandments for the Regenerative Receiver:

1. Keep the Feedback Simple

If your sale desire is to laten to entertainment on the \$60 and 400 meter wave lengths, you can make your own regeners tive receiver very economically. All you need is a vacuum tube with socket and rheostat, one variocoupler. and a variable condenser. Of course, telephones, grid leak. grid condenser, phone condensor, aerial, and the necesmary butteries are required to complete the circuit. By using the simplest form of regenerative hook-up shown in Figure 3. on the following page, your receiver is reduced to two controls saide from the filament adjustment.

This most simple type of receiver will give excellent results if the following directions for hook-ups are observed

carefully:

THE TUNING CIRCUIT is made by placing the variable condenser in series with the serial, the primary of the variocoupler, and the ground connection. I have found that for the 860 and 400 meter waves, the tuning often can be done almost exclusively with the condenser, leaving a fixed number of turns in use in the variocoupler

THE ORID CIRCUIT lead is taken from a point between the variable condenser and the variocoupler junction. This lead goes to the grid con-

denser. The other side of the grid condenser is connected with the grid terminal of the vacuum tube, both connections being made as short as possible. Shunted scross the grid condenser you should have a high resistance leak of one megohis. The other side of the grid circuit consists of a connection between the positive terminal of the storage battery and the ground side of the variocoupler primary. The reason for this connection is that the positive side of the storage battery will attract the By Jack Binns

negative charge that accumulates on the grid and permit it to leak off through the high resistance. The grid condenser is in this circuit to permit the high frequency currents to pass through from the tuner to the grid without interfering with the function of the grid leak.



This Ingenious Deak Radio Set Built from POPULAR SCIENCE MONTHLY'S Blueprint

MOUNTED on a panel that fits into an old writing desk this two-stage vacuum tube receiving set, constructed from Poputan Science Montana's blueprint by Victor C. Beetow, of Elkhorn, Wia, in giving remarkably successful results. Its owner writes:

"The foudspeaker is bolted to a shelf attached to the back of the deak "says Mr Bectow."The B batteries -I use five of them of 22% voits each—are on a shelf underneath the set. All wires come through the back of the deak.

"From the storage battery of my car parked just outside the house I obtain current for the three vacuum tubes and the loudspeaker, using a long piece of lamp cord attached with spring clips. Since I drive my car considerably, the generator on the car supplies plenty of current for both car and radio set, and so I never have a run-down A bettery.

"Several persons have stated that my set brings in concerts louder than any other sets they have listened to."

Mr. Bectow is just one of scores of readers who have expressed their astasfaction with results obtained from acts built with the aid of POPULAR SCIENCE MONTHLY's blueprint, which includes wiring diagram, details of construction and bill of materials.

To obtain one of these blueprints send 25 cents to the Blueprint Service Department, Popular Science Monthly, 225 West 39th Street, New York City.

THE FILAMENT CIRCUIT consists solely of connections from the storage battery to the two filament connections of the socket. The rheostat should be placed in the negative side of the storage battery in order to give the filament greater positive potential with respect to the grid. This is important.

IN THE PLATE CIRCUIT, a wire should connect the plate terminal of the socket and one ade of the variocoupler rotor. The other side of the rotor should be connected with one side of the telephones, while the other side of the telephones should be joined with the positive terminal of the B battery Join the negative terminal of the battery with the positive terminal of the storage hattery.

The set is now complete, with but two controls to adjust—the condenser in the serial circuit for wave length, and the

rotor of the variocoupler for regeneration. With the first control you get resonance with the transmitting station and with the second you get the greatest amount of volume possible for a regenerative receiver. That's all there is to it, except the simple control of the filament rhematat.

After experience you may find that the rotor can be left set and a slight variation in the condenser will tune out a 360-meter station and bring in a 400-meter station, chminating all interference.

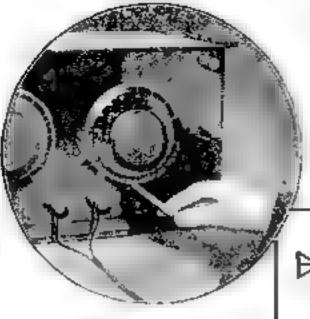
2. Keep the Tickler Out of Temptation.

From a large number of renders' letters it is apparent to me that the average newcomer in radio does not fully understand the action of the "Lirkler" or feedback co.l. which gives regeneration. In the first place, it must be understood that the vacuum tube itacif has remarkable amplifying properties. The small currents received on the serial are transferred to the gridthe control element of the tube and thus, governing the flow of electrons from the flament to the plate-immediately releases the large amount of energy stored up in the plate circuit and puts it to work in the phones.

Now, if we can get a large amount of energy on to the grid, we can release still more of the energy in the plate ctrcuit. This is what the feedback coil does. After the initial impulse comes to the mid, it sets the plate circuit into operation. The energy from this circuit is passed through the tickler coil and by inductive means this energy is transferred to the grid circuit, which in turn again affects the plate. Such action is repeated instantaneously in each case

until a certain maximum is attained, beyoud which regeneration will not proceed because the tube goes into a state of oucillation that is excellent for transmission purposes but uncless for reception.

Unless properly used, regeneration has a number of distinct drawbacks, one of which is squealing or howling. From the troubles that have been reported to me, it is apparent that a number of fans put the B bettery positive connection next to the plate terminal of the socket. This method



For Vernier Adjustments

To make close adjustments, prom the rubber craser of a pencil against the notched edge of the tuning dial so that the rubber acts as a gearing. A slight turn of the pencil will then move the dial through an angle smaller than would be possible by turning the knob of the dial most carefully with your fingers.

of connection is incorrect, for it is necessary that the tickler should be joined directly to the plate terminal of the vacuum tube. Then the telephones should be connected with the other side of the tickler coil. After the telephones, the B battery can come in, but not before,

After the connections are made, it is possible that no regenerative action will be experienced. This may be because the tickler coil is opposed to the primary winding of the variocoupler. In this case it will be necessary to reverse the connections on the tickler. Experiment will soon determine whether you have the connection right. The method by which you can determine this is described in the following commandment:

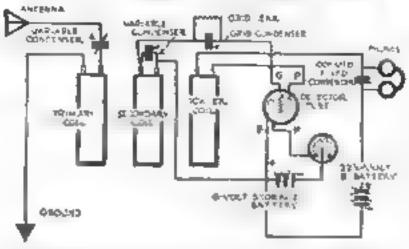
3. Worship the "Zero Beat."

Perhaps the most perplexing term in radio for the beginner is "zero beat." To understand it, another terrifying term-"heterodyne effect"-must be explained. First remember that the transiniting station consists of a radio out exactly the same in general principles as the single circuit reconver described in the first commandment, the main difference being in size and power. In the transmitting set, however, the feedback coil is so arranged and its filament so adjusted that the tube is in a constant state of oscillation, the frequency of this osciliation depending upon the inductance and capacity of the circuit shout it

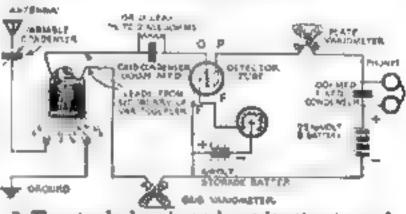
Let us suppose that this frequency is 800,000 cycles a second -producing a wave length of approximately 875 meters. Any receiving apparatus that responds to this wave length will be unable to record anything in its telephones because the frequency is far too high for the telephones' disphragms to respond to Now, if we turn our receiving apparatus

THE discovery of new methods of radio frequency amplification that can be applied by amateurs and even by novices, is probably the most important of recent radio developments. Jack Binns will tell you about it in next month's issue.

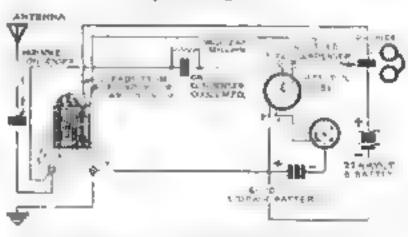
Four Methods of Regeneration



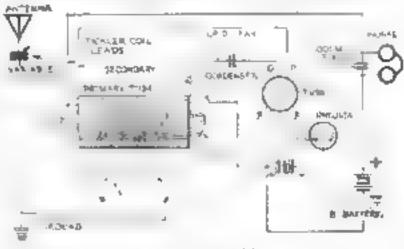
 Regenerative hook-up for standard honogroups soil type of receiving set. Regeneration is obtained by the feedback between the tickler coil of the plate and the secondary coil of the grid.



2. The standard variocoupler-variometer type of regenerative receiver. The plate and grid are tuned by variometers and the energy of the plate is fed back into the grid through a consection between plate and grid



 One variation of the tickler coil principle. The accordary of a standard variacoupler is connected into the plate circuit and acts as a tickler coil, feeding back energy of the plate into the grid



t. Here a second rotor cell is added to a variacoupler to act as a tickler cell



Saving the Rheostat

"In mounting the rheestat, take care," says Jack Binns, "that the contact arm makes firm connection with the resistance wire." An effective way to do this is shown above. With your thumb press down the arm at the shaft, and at the same time tighten the actorew, assuring permanent and firm contact

into a transmitter for a moment by making the filament glow brighter and increasing the feedback coupling, we can ourselves produce oscillations of a frequency as high as we desire within the limits of our tuning coil and condensers.

To understand the effect of this, consider for a moment the action of a tuning fork. If a tuning fork vibrating 256 times a second is placed near enother fork vibrating 260 times a second, a listener a short distance away will hear a sound alternately swelling and dying four times a second—or of a frequency equal to the difference in frequencies of the two forks. In the same way, if two trains of radio waves of different frequencies interact or "Interfere," the result will be a wave having a frequency equal to their difference. If, then, in our own receiver, put in a state of oscillation, we produce a wave having a frequency of 800,500 cycles a second, the interaction of this wave with the wave of 800,-000 cycles a second will produce a ' beat" wave having a frequency of 500 cycles a second which, since it is an audible frequency, will be heard as a musical note n the That is the underlying phones. principle of haterodyning, Now, if you pay careful atten-

tion to the adjustments in producing this effect, you will observe a peculiar thing. The musical note will vary in its pitch as the disl of the condenser is turned. This variation will be from a very shril. high pitched tone to a very low gitched tone or vice versa, depending on the relative positions of the movable and stationary plates of the condenser. If you keep turning the knob, a position will be reached where the pitch becomes very low and the sound finally stops. If the knob s turned still farther, the low pstched note will begin again and

Your Radio Questions Answered

Address your questions to POPULAR SCIENCE MONTRLY, 225 West 39th Street, New York City, inclosing self-addressed stamped arradops

Amplification for Crystal Detector

Q. Can radio frequency or audio frequency amplification he used in connection with an ordinary crystal detector?—A. R. D.

A. Both radio frequency and audio frequency amplification can be used. All that a necessary is to connect the output terminals of the radio frequency amplifying unit to the input terminals of the cryatal detector circuit, and the output terminals of the cryatal detector circuit, and the output terminals of the audio frequency amplifying circuit.

Potentiemeter Connections

Q How son I connect a potentiemeter into the circuit of a two stage regenerative set?—Howard O. Gardner.

A. To connect the potentiometer, disconnect the wire leading from the negative pole of the B battery to the A battery. Then connect the lead from one and of the resistance to the positive pole of the storage

battery. Then connect the movable contact of the potentiometer with the negative pole of the B battery

Grid Leaks and Grid Condensers

Q. What are the best since of grid leaks and grid condensers to be used in repengrative sincuits?—Denald A. Larkin.

A It is impossible to determine beforehand just what values of grid condenser capacities and grid leak resistances will give you best results. You will have to try out various values. For the grid condenner either a .0005 or .00025 mfd fixed condenser can be used. For the grid leak a resistance of from 14 to 5 megohina can be used. You can obtain tubular grid leaks of various sisce and substitute them into the circuit until you get best regults with a certain size, or get one of the variable pencil mark grid leaks whose reststance can be varied by increamng or decreasing the number of pencil lines until best results are obtained.



Jack Birms

Increasing Distance Range

Q. How can I increase the distance range of a two stage audio frequency amplifying out?—A. V. Monaice.

A. The distance range of a set can be increased by the addition of stages of radio frequency amplification. This form of amplification, however, is difficult to handle satisfactorily, and is not to be recommended unless the operator understands vacuum tubes and transformers.

If become higher and higher in pitch.

point between the two low pitched.

notes where the receiver given it no sound at all, is known as the "zero."

This is the best possible adjustment the set for the reception of music, for the son that maximum volume will be obsert the reception of the set.

What ready happens, of course, is this, the sare best the incoming wave has etly the same frequency as the wave it the receiving set is producing and, sequently, they do not clash. When the o best has been found on the set, the sets of the detector tube should be no that less current is flowing the finment. As the rheostat is in this manner, it will be observed the signals increase slightly in strength first and then decrease. The rheostat is he left at the point where they are

tuning a regenerative receiver to a sudenst my station, you should turn on finament full and then, with your of apparatus, search for the carrier of the broadcasting station. You will be then from the characteristic whistle the receiving set heterodynes on the ner wave. The next thing is to adjust out at and tickler for the zero heat and to manipulate the rheostat so that the rest music is obtained.

the value of the remier adjustments in a very receiver, especially in contion with the feedback adjustment and variable condenser adjustment, cannot overestimated, since it is possible to a station in or out by the elightest verifield, one way or the other, of the lin that control these adjustments. A thod by which such an adjustment by be easily made is shown on page 70.

In Protect the Receiver with Shields.

Ine of the peculiar things about a relerative receiver, especially on short
we lengths such as are used in broadting is body expecity. This is the conion that exists in all unshielded sets,
doubt you have observed that imintely after an adjustment is made and

your hand is withdrawn, the set begins to aquest. If the adjustment is in a certain position, thus aquesting will stop as soon as you return your hand to the adjusting dist. On other occasions when the set is functioning perfectly, the moment you approach it, a terrific aquest will issue from the telephones.

You can eliminate this troublesome body capacity in only one sure way—by groundshielding the set. Line the hande of the cabinet with very thin copper plate or tin plate. Solder the plating wherever there are any joints. It is necessary, of course, to make holes in these plates in order that the different connecting wires, the shafts of the variable instruments, such as the condenser, tuning cods, and other paris, can he passed through without touching the shield. The shield should then be soldered to the ground connection. If this is done carefully, the squeaking affect produced by the body will be eliminated and accurate tuning will be possible.

In cases where the feedback coil is in an inductive relationship with the tuning elements of the receiver, a shield should not under any circumstances be placed between them. There is one exception to this rule, however, and that is in case of the variocoupler two-variometer type of receiver. In this case shields can be placed between the three tuning elements, for regeneration in this type is obtained by tuning the three circuits into union, as will be explained later.

5. Do Not Occupant the Rhendal,

The filament rhecatat is the most important element in the regenerative receiver. It is constructed so that it can be mounted into a panel in two different ways and, in order to facilitate this, the manufacturers have made it so it can be taken apart easily. When mounting the rhecatat, it is important to make sure that the contact arm is in firm contact with the resistance wire. If this is not done, the arm will make only a loose contact, with the result that when the rhecatat is turned on, an areing will take place at the point of contact, rapidly burning the wire on the

rhesesat and destroying the instrument,

There is one other thing to consider about the rhemial limit. In resisting the flow of current, it becomes beated. To keep the coils as cool as possible, be careful to mount the rhecetat inside the cabinet in such a way that a free circulation of air can carry off the heat, which might otherwise hum out the resistance where.

Since heat rises, the rhecatat should not be mounted inside the top of a shadow cabinet nor should colla be placed in a stuall space. The best mounting for a rhecatat is on a vertical panel clear of the other instruments in the receiving set.

Remember that the average rhecutat in general use is designed to regulate the filament current of one tube only. When more than one tube is controlled by a single rhecutat, the temperature rise in the resistance coils may become excessive.

6. Honor the Inductive Relationship.

Whatever type of regenerative receiver you may use, whether it is a honeycomb coil, a variocoupler with tickler coit, a variocompler alone, or a variocompler and variameter, remember that the inductive relationship of the feedback coll to the tuning apparatus is of utmost importance. To explain inductive relationship simply, we may state that if alternating or pulsating current is flowing through a coll, it will set up a similar current in any other coil that is in the correct rolationship with it This interaction between the two will be stronger or weaker, according to the distance the two cods are from each other A little experiment will show that there is one point is the distance between the two colls where a maximum induction taken place between them.

For those fans who assemble their own regenerative receivers, this position can be very easily determined before the set is finally mounted on its panel by the method fully explained in my department last month.

The a angements for varying this inductive relationship are amply provided for in such instruments as the variocoupler (Continued on page 103)

Is Your Car Really Fixed for the Winter



By Harold F. Blanchard

OST of un who companie whenever our nutomobiles are afflicted with "winter troubles," fail to consider that cars, like human beings, are sensitive to gold weather, and that if we would avoid expense and worry, they should be properly fed, clothed, and adequately protected from wintry blasts.

Balky engines and frozen radiators are curses of wintertime driving that might be easily prevented if car owners would take the time and trouble to make a few simple preparations before the coldest weather.

Two Essential Precautions

Two of the simplest and yet most important items of protection for the car are these:

Pood: Adjust the carburetor to give a richer mixture in cold weather.

Clothing: Clock the radiator with a cover or shutter:

Why does your angine require more gasoline in winter than in summer? Simply because gasoline does not vaporize and mix with cold air as readily as it does with warm air. Furthermore, cold air in a cylinder weighs more than warm air and therefore requires more power behind the piston to duplace it.

The reason the radiator needs a covering or shutter is that the usual cooling system is designed to cool the engine in hot weather and becomes supereffective in winter.

A shutter is ideal for regulating the temperature of the engine. It may be opened or closed by a handle on the instrument board or by a thermostat located in the shutter. A radiator thermometer is essential, otherwise it would be difficult to determine just what the temperature of the engine is. A hood cover is a further economy because it prevents dissipation of heat into the atmosphere, with consequent waste of fuel.

Supplementing these simple preparations in the use of soft grease for the cups. Lighter oils and greases are often advisable, but most engines will operate saturactorily with a medium oil all year round.

Just why does an engine balk in cold weather?

One of the chief reasons has already been mentioned—alow raportantion of gasoline. A second important cause is that the battery is likely to be below normal. In winter the car is used chiefly around town. The engine is stopped and started fre-

quently and is not run continuously enoto keep the battery charged. Furt more, the fact that the engine is harde start in winter strains the battery. Lip are used more during the shorter days, cold weather itself number the batter For all these reasons the battery should given an outside charge as soon as it sho signs of weakening.

Starting the Cold Engine

Engine starting in another difficulty (is almost an troublesome to the unprepa outo owner as engine balking. In m erately cold weather the average dri usually raises on his choke to start a c engine. But this method is effective of if the battery is in good condition, spark plug points are properly set up, the breaker points adjusted to the corr gap. Many butteries have worn because the choice was not doing the wa it was supposed to do. Choke parts n wear, stick, or slip, or the choke may no have been properly adjusted. The c thing to do in getting ready for wint therefore, is to see that these parts in good condition and carefully adjusted

When cranking the engine, the chishould be pulled out all the way. But coshould be taken to push it back as soon
the engine has warmed up a little. If it
engine is operated with the choke out, we
bearings and worn cylinders must res
because of excessive dilution of the engtubricant by the large amount of rgasoline the choke forces the engine
threaths. When the choke is not suffic it
to etart the engine, the carburetor may
flooded by rawing the float valve off its an
and holding it off until fuel leaks out of a
carburetor

Ether Useful in Zero Weather

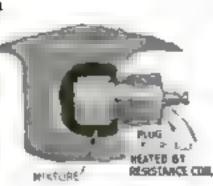
But when zero weather comes, the simple expedients often fail. If a car is been thoroughly chilled by standing in unheated garage or by remaining in topen several hours, it will require primit of the cylinders with gasoline to start. If this first aid has no effect, ether should used for priming. A pint bottle sufficie to last most motorists all season costs abs 60 cents. The ether may be introduced

Three Best Remedies for a Balky Engine Designed to make the auto engine start readily in the coldect weather, there there electrical devices heat and thus quickly appealing appelling in the

Designed to make the auto engine start readily in the coldest weather, these three electrical devices heat and thus quickly vaporize gasoline in the intake. Any one of them may be installed easily



This electric mixture bester consists of an electrically heated grating mounted in a gasket placed between carb uretor and intake manifold



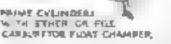
Here the mixture is warmed by a plug electrically heated by a resistance coil and screwed into the manifold



In the typical primer is inserted a resistance coul that vaporizes fuel drawn from the vacuum tank by a plunger on the instrument board and sprayed into the manifold How to Start Your Car in Cold Weather

PULL OUT CHOSE OR DEPRESS HE FLORT MEEDLE







FILE MADIATOR WITH PUT GASOLINE ON SPARK PLUGE AND APPLY MATCH

priming the cylinders through the petcocks or by etherizing the carbureter with a rag moutened with the substance. Then, if the car doesn't start, the gasoline should be turned off, the carburetor drained, and the float chamber filled with ether. After that, turn on the gasoline and crank the engine. With that shot of other, even the balkiest engine should start immediately and continue running on the other until it is warm enough to run on the gasoline.

The typical primer constata of a plunger on the instrument board that draws fuel from the vacuum tanks and sprays it into the intake manifold. The engine may also be primed by squirting grantine into the petrocks. If these are clogged with carbon, they should be bored out with a small screwdriver, gimlet, or drill. If the engine has no petcocks, spark plugs equipped with priming cape may be purchased.

Emergency Measures

If you have not taken the precaution of carrying a bottle of other for amergency and your car should be stolled in the country where ether is not obtainable, the best plan is to drain the cooling system and fill it with hot water. Other first aids are these; Remove the spark plugs, pour gasoline on them, and touch a match to them, then screw them back quickly before they lose their beat. Pour hot water over the earburetor, or wrap the carburetor in warm cloths or

warm and, anything to warm it up. Refusal of the engine to start may be due to the freezing of water in the carburetor or In the gasoline piping. Any water that happens to be in the gasoline, or that condenses from the sides of the gasoline tank, will collect in a low spot and freeze. A gasoline filter is the only sure preventative and every car should have one. A less certain cure is to drain a sittle gasoline out of the carburetor bowl frequently, since any water that collects is likely to come off

By far the best preventative for a balky engine is an electric maxture beater, consisting either of an electrically heated plug that screws into the intake manufold or a heat wire mounted in a special gasket and placed between the carburetor and the intake manifold. The heat generated quickly vaporizes the gasoline in the intake and the origine starts readily in the coldest weather.

If you use an electric mixture heater, it is not always necessary to heat your garage, provided the radiator of your cur is filled with an anti-freezing mixture. However, it is well to keep the garage heated, if possible. You can do this by

connecting the garage with the house heating system. Or you can purchase one of the automatically regulated gas or kerosens heaters especially designed to heat garages and keep automobile engines

MUMIC ENGLISHED AN A OA TENS THREE OR PET

SPARE PLOS

When the delivery duct of the heater is set up against the car radiator, the warm air heats the water in the radiator and so maintains the heat of the engine. Another type of gan heater draws water from the

filling it with anti-freezing compound is ac easy and so mexpensive that there is really no excuse for neglecting it and auffering the consequences. Anti-freezing compounds that give the best results are denatured alcohol, wood alcohol, glycorin, calcium chiorid or mixtures of these. Calclum chlorid is probably the best, because it does not evaporate like alcohol. Be sure that it is chemically pure or it is likely to corrode the engine.

For a pero freezing point, three punds of cacium chlorid to a gullon of water should be used, while (our pounds to a gallon will give a freezing point of 17 below serp. Either a muxture of 40 per cent denstured alcohol and 60 per cent! water, or 24 per cent wood alcohol and 76 per cent of water gives a zero freezing point. A 48 per cent mixture of glycerin and water freezes at zero and a 58 per cent mixture at 10 below. Equal parts of glycerin and alcohol mixed with 71 per cent of water will give a sero freezing point. Many motorists use anti-freezing compounds on the market,

Know Your Car

T IS just as important to keep your storage battery charged as it is to keep your tires inflated. An uncharged battery will soon be rumed. Overcharging also is injurious.

You can determine the condition of your battery by the tone of your auto horn. A high pitch indicates an overcharge a low patch, an undercharge.

Lack of sufficient water ruins more batteries than do ever

charges and undercharges.

You'll remember these simple, worry-saving facts more easily if you understand the construction of your battery. It consists of a "battery" of cells connected in series -one cell for every two volts. Bach cell consists of a hard rubber jar filled with thin, vertical plates, alternately positive and negative, sone rated by wood or rubber. The positive plate commiss of a lead framework filled with lead peroxid. The negative plate contains pure lead in a porous state.

The plates are im-nersed in a solution of sulphuric acid and water, caused 'electrolyte,' much heavier than water. As the battery discharges, the lead and lead peroxid on the plates are changed to lead oxid on both plates and there is also a forms tion of lead sulphate that causes the lowering of the specific gravity of the electrolyte by the loss of sulphur and oxygen.

The condition of the electrolyte in each cell should be tented. frequently for specific gravity with a hydrometer syringe. The specific gravity should be mixed only by charging

> draincock of the car radiator, heats it, and then discharges it into the filler opening at the top of the radiator. Still another device is an electric beating pad, which when placed under the bood in capable of generating sufficient heat to keep the water warm and permit easy starting.

Neglect that Brings Ruin

Even if you have one of these water beaters, it is dangerous to assume that the anti-freezing liquid may be dispensed with. Countless radiators and engines are ruined every year because this precaution is not taken.

How can you tell when your automobile is frozen? There are several ways. For example, if your car is equipped with a water pump, the chances are that you can't crank the engine. Or if you do crank it, the pump will break. If you have no water pump, the first indication of freezing may be a steaming radiator. Blocked by ice at some point in the system, water is tenable to circulate and gradually turns into steam, blowing out of the radiator

The task of draining the radiator and

Draining the Car

If the car is exposed to gold weather without the protection of an anti-freezing liquid, the cooling system should be drained. Make sure that no water remains in any part of the system. Water in the engine oil sometimes blocks the circulation and, if it freezes in the pump, may break it when

the engine is restarted.

I have outlined the most important preventatives of automobile winter troubles, the causes of which, it must be emphasized again, usually originate in our own neglectfulness, rather than in our cars. A few secondary precautions and conveniences are also important to the enjoyment and safety of winter driving Chains should always be used when there is snow on the ground, especially when there are hills to chimb. If the snow is well packed, it is essential that the chains be attached so that the fastening links will tend to close when the chain slips and to open when the wheel slips.

To keep your hody warm while driving, a footwarmer operated by the exhaust may be purchased. There are a number of varieties of these on the market. Another type uses bot water from the radiator, and still another is a charcoal heater that burns

for bours without odor or finme.

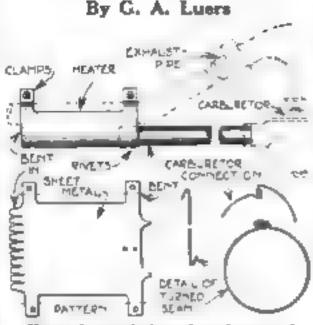
A hot water bottle placed under the robe on your lap, electrically heated gloves, or electrically beated pads laced to the ateering wheel will help remarkably when you suffer from cold fingers. Such comforts make winter driving a pleasure

Carburetor Heater Helps to Save Gas

THE average carburetor heater is not sufficiently large to obtain makimum economy in the use of gasoline, especially on cars several years old. The cerburetor and intake manifold should be too hot to place the hand comfortably, for then the gasoline and guioline vapor in contact with these surfaces separate into the vapor most readily burned when It reaches the cylin-

ders. Any owner of a car can add to the carburetor a heater that will supply an abundance of warmth and result in economical operation, with the added advantage that the car can be throttled down to a lower speed

The body of the heater is sheet iron formed to a pattern as indicated and secured with clamps to the exhaust



Heater is attached to the exhaust and connected by pipe with the carburster

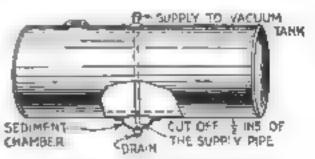
pipe. The connection with carburetor is by means of a pipe rounded to shape over a mandrel. and bent wherever necessary to bring it in line with the earburetor. This connecting pipe is fitted with an adjustable opening That can be arranged in any conventent way for use in hot weather

As a preliminary to forming these beaters, a pattern of the part should be made of beavy

paper and fitted in place. When the pattern is correctly fitted, the metal is then cut from the paper pattern. The immediate effect of the added heat will be noted in the carburetor adjustment. As much a reduction as a half turn of the needle-valve is obtainable after operating the motor several minutes with the heater properly connected.

To Keep the Automobile Gas Line from Freezing

EVERY winter gas lines freeze because of water in the tank. This is mainly due to the fact that water gets into the garage gasoline supply from the street level because the driver of the supply wagon does not sponge out the filling chamber before unscrewing the cap, thus allowing our and melted know to run into the stor-



Lower and of supply pipe in tank is out off.

age reservoir, from which it is pumped into the tanks of automobiles along with the gasoline.

I found that by cutting off about 1 ½ in from the lower end of the supply pipe, a reservoir of more than a gallon is formed at the bottom of the tank

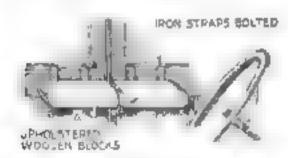
There is another advantage in this arrangement: If you happen to run out of gasoline, you can unserew the tank plug and fill some of the reserve into the vacuum tank.—ERNEST T OLDFELT.

Arm Rest Relieves Fatigue of Driving Ford Sedan

TO DRIVE a Ford sedan many miles is the treatment because there is no logical place to rest the left arm, so I built a rest that allows my arm to slide backward or forward.

Two blocks of wood 6 in long are used, A fastened to the left door and B to the left front window trim. Each one is rounded on one end and the outside edge and then covered with uphoistery, as illustrated below.

Two strap irons were screwed to the flat inside edge of each block and boited



The error rest in place

through the window trim and door. By unloosening the nuts, the bults can be removed at any time and the rest taken of There are no fastenings to vibrate, as on portable arm rests.

The ends of the blocks almost butt together when the door is closed and make a continuous rest.—L. B. Robstva.

How to Avoid Noisy Shifting of Gears in Cold Weather

IN COLD weather, when the oil is the gearcase is more aluggish than in summer, we are apt to do more noisy gest shifting. The reason for this is that it is harder to move the gears in and out of mesh when the lubricant is heavy, and this means we often allow one shaft to slow

Trick Wiring Quickly Starts Stalled Car

A MOTORIST in distress recently asked for help because his ignition had failed. In view of a threatening anowatorm and rapidly approaching darkness, it was desirable to remedy the

trouble so quickly as possible. A hasty examination showed that the fuse was intact, but the maze of wiring of the switchboard and the connecting instruments was far too complicated to detach and make

any repairs, even with the manufacturer's chart at hand to explain the intricacles of the wiring. Nevertheless, we had the motor running is less than five minutes. The means used was simply a 12 ft length of insulated wire connected as shown

When the ignition fails and the trouble seems to be somewhere between the coil and the battery, the quickest way to get the engine going is to run a special wire direct from the battery to the cour

Insamuch as there are usually from two to four terminals on the coil, it is not always easy to say which is the right one Sometimes the manufacturer's instruction book will indicate it, or the right terminal may be determined by trial, usually it will be the terminal which indicates a live circuit when tested by the simple process of rubbing the special wire on it when the breaker points are

closed. In connecting the end of the special wire to a terminal, be sure that the regular wire has first been disconnected

The other end of the special wire should be connected with the

Care must be exercised to obtain a good connection at this point. Scrape the electrode clean, and if any difficulty is then experienced in obtaining a good spark, make a nail hole in the electrode and wedge a few strands of wire into it, as illustrated

When this connection is made, the ignition switch will be inoperative, but the engine may be stalled by bringing the car to a stop and letting the clutch in gently while the brake is on. Care should be taken to crank the engine iramediately after making the connection and to disconnect the wire as soon as the motor stops in order to prevent the consideroming overheated.—M. R. V

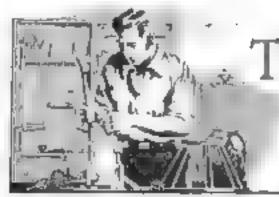


A length of insulated wire, kept for emergency, in run directly from bettery to coll

down too much in relation to the other, causing clashing

Or, due to the sluggish lubricant, the shifted gear-treth are allowed to grate against those of the other gear, with the same clashing noise. The experienced driver, therefore, uses a lighter lubricant in cold weather, and, in fact, most of the oil companies recommend a lighter grade of gear compound for winter use. In any case, use more force and remember the causes of the clashing, and you will be less apt to shift noticely.

Throw the gears into position with a quick, positive stroke and you will seldom have trouble.— F. J. J.



The Home Workshop

New and Useful Things to Make with Tools

Building the Ideal Home Workshop Bench at Home

Plans for a Cabinet Type Workbench and for Other Kinds that Can Be Made at Little Cost

TOTHING is more essential to the comfort and pleasure of working with tools than a strong, substantial bouch with a good vise. If it is like the cabinet workbench illustrated at the right and has drawers and tool cabinets. so much the better, for it is a constant incentive to keep took in order and to give them the care and attention they deserve. With such a bench and a set of tools of standard quality, the home worker can hardly fail to do a hundred and one useful and interesting jobs that otherwise would never be undertaken.

This cabinet bench, which has been designed by the Home Workshop Department as an ideal workbench for the home shop, has three drawers for tools, an end cabinet for saws, steel square, and other flat tools, and another locker opening from the front near the vice to take the drawingboard, T-square, roll of drawing paper, blueprints, and other drafting equipment.

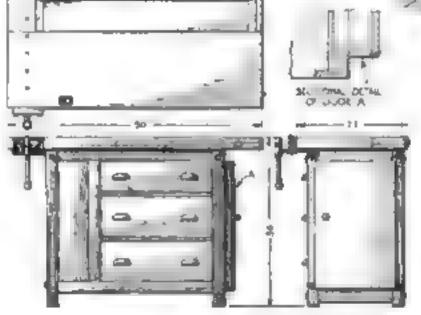
Mechanica differ in their preference us to the height of a bench, some authorities recommending benches as high as 89 in. and others

as low as 32 in. The stundard practice is 83 14 or 84 in. This bench in 84 in. high and has a top 22 in. by 4 ft. 2 in. The working part of the top is 15 in, by 4 ft. 2 in , the rear part being a tool receas. Provision to made for the usual 7-in, wood-

working vive. If a larger one is desired, the top should be abifted to the left for enough to accommodate the vise. A machinist s

Sect of foot excess-bad 2

THE accompanying article contains full instructions for building the ideal home workshop banch. Readers who desire, in addition, complete working drawings and bill of materials may obtain our workbench blueprint, No. 15 In the Home Workshop series, by sending 25 cents to the Blueprint Service Department, Popular Science Monthly, 225 West 38th Street, New York.



CROSS C. F - FRE SERVICE PARKING EXTENDED SHE CATS MASTE TOP - 15 - 4 8"

The home workshop bench and diagram, showing how to cut the top, lays, and ralls from one plank 15 in. by 14 ft. or two planks 7.1/2 in. by 14 ft.

MANY FOR THEY PETERS NOT

vise can be clamped to the top toward the right-hand end whenever needed

The top, tool recess ends, legs, and rails

are all of 21/4, 21%, or 236-in, maple. All the parts can be sawed from a single plank 15 in, wide and 14 ft lung, or two plants 7 14 in, wide and 14 ft. long, provided they are laid out in the most economical way, as shown in the accompanying disgram. In getting the stock for the bench, it is advisable to go to a lumber yard and select a sound maple plank or planks so near as possible to these dimensions (the thickness being more or loss im-

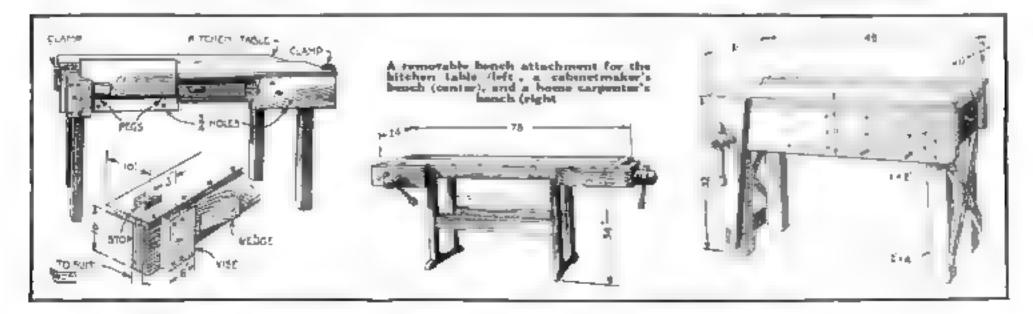
material, provided it is more than 2 in.), and have it sawed in the lumber yard

The completed beach. N cemb locker for saws

and other flat

Either lay out the Hose directly on the plank or else attach accompanying gram or a copy of it to the order charge for sawing will

be reasonable and the total cost will be conaderably less than if a bill of materials for (Continued on page 93)



How to Build Efficient Home Radiator Humidifiers

Two Tested Devices that Are Easy to Construct and that Have Large Surfaces of Evaporation

By James S. Godfrey

TRAY DETALS -

MAL PASTERING

IN MICESSIAN)

TEAMS TO EXPE

GALVANIZED SHEET BON BOX AND TRAYS

CLOTH HEMPED TOP AND BOTTOM

CALL SHEET

WITH LEVEL

-72

- 5" 10P --

Our universal neglect of the precaution of moistening the air in our homes, in winter, to protect the family against colds and other winter infectious, was assailed in a remarkable erticle by Harry Mount, in the December terms of POPULAR SCIENCE MONTHLY. This unhealthful droness of homes heated by sleam or hot water radiators can be remedied by either of two tested humidifying devices, designed by E. P. Lyon, Dean of the Medical School of the University of Mannesota. Readers who wish to construct a set of humidiflers to mount on their radiators will find ealuable the drawings and construction details in the following article.

The best method for securing a proper circulation of maint air in a home heated with a pips or pipeless furnoce was described fully In the Nasember Home Workshop, which also contained instructions for making and reading a hugeometer—the simple instrument used to determine whether the relative humidity in your home is adequate. - Thu Editon.

WO types of radiator humidifiers. that will evaporate approximately 1 16 to 3 gallons of water a day for

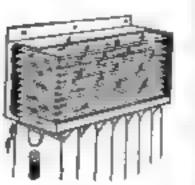
each lineal foot of radiator, can be built at little cost formaterials. by may one who can solder a tight seam. One hunuclifier consists of a seriest of trays, and the other of a series of small troughs in a galvanized iron easing. These are placed over

the radiator in such a way that warm air uscending from the coils passes over a large area of mouture.

AND TROUGHS Upper views show working details and completely assembled humidifier of the tray type; the lower drawings make clear the construction of a typical trough humidifier with cloth curtains If it is not desired to undertake the sheet metal work involved, the humidifiers may be made to order at a tin shop, for a reason-

CHA 2949 M

able sum, from the accompanying details. Samply select the type of humidifier preferred, clip out the illustration, pasts it on a sheet of paper and note beneath it the length and width of the tops of the radiators for which humid-



9005

there are to be made. Indicate also whether the tops of the radiatom are flat or rounded; If they Are rounded, provision must be made for fastening the humidifiers against the Wall

The first type of humidifier is an arrangement of shallow enlyunized from trays placed one above the other with 36in, intervals between. The trays are as long or a trifle longer than the radiator and their ends are soldered to two gulvanized from end pieces. The width of the trave varies. becoming wider toward the top, except in the case of the uppermost tray, which is a trifle narrower than the one below in order to avoid the danger of aplashing water on the floor when filling it.

Each tray is 1/16 or 1/4 in. deeper at the back than the front, and the front edge is placed at an angle. This arrangement is necessary in order that the overflow wall not run down the back and

through to the floor but over the front edge and into the tray beneath. The bottom (Continued on page 115)

Wallboard Makes Fine Crokinole-Carom-Checker Board

NE of the lade who posed for the accompanying photograph of a homemade crotonale and checkers board became so interested in the board that I furnished him with a rough sketch. and he hurried home to make one just like it. Two days later, when I met him in the paint store, he told me that the board was then ready for the finishing touches. Bo,

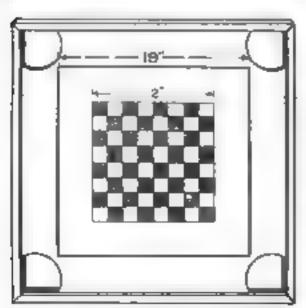


Fig. 2. How to lay out the carem-checker side of the board

By A. Neely Hall



Fig. 1. A hotly contested game

you see, it does not take long to make one, and if you do your work well, you will have a game board that will last long enough to be handed down to another generation.

Figure 1 shows the side of the board on which crokinole is played. Figure 2 shows the opposite side, on which checkers, caroms, and other games are played.

The most satisfactory material for the board is wallboard. Two pieces are needed, a square piece, A, Fig. 3, and a circular piece, B. The smallest size sheet in which wallboard comes is 32 in. by 7 ft. There will be several feet of waste in this sicc

sheet, but there are so many things that can be made of wallboard that you should be able to use practically every scrap.

Wallboard is easy to cut. You can saw it just as you would saw a board, or you can cut it with a knife. In using a knife, you

(Continued on page 96)

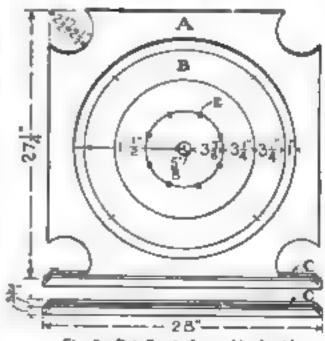
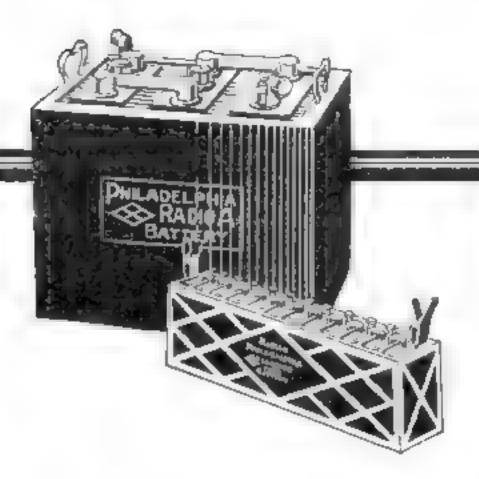


Fig. 3. Detalls of the troblesis side and strips for the feams



Drynamic Radio A and B Batteries



Stop

"frying" noises in your radio!

The new Phileo Drynamic Radio Batteries absolutely climinate objectionable battery noises. Also need for frequent and troublesome tuning in. Think of the increased pleasure and astisfaction you can now get from your radio set!

Phileo Drynamic Batteries are a revolutionary development in battery engineering. Their phenomenal new "Phileo Process Plates," plus other time-tested features, insure constant, uniform voltage—an absolute essential for satisfactory radio reception.

Charged DRY at the factory, the life of a Philos Drynamic Battery doesn't start until you pour in the Philos Electrolyte. That means you get a 100 per cent new storage battery. And without the inconvenience of waiting for an initial charge.

Philco Batteries also give you the longest service per charge and the longest battery life. They are attractively finished—sealed tight to prevent acid leakage—convenient to handle.

Ask your radio dealer to show you these remarkable new Phileo Batteries—or go to the nearest Philadelphia Diamond-Grid Battery Service Station.

RADIO DEALERS—Philos Drynamic Batteries let you into the storage battery business on a package goods basis. No acid sloppage. No charging equipment. No batteries going bad in stock. Wire or write for details.

Philadelphia Storage Battery Company, Philadelphia

Makers of the famous Philes Scotted-Retainer Batteries for automobiles, electric passenger cars and trucks, mane tocomotives and other high power, beauty-duty battery services.



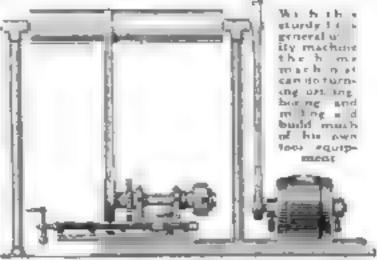
Mail This Couldon Long and arrive the first Printer of the State of th

"Universal" Machine Gives Wide Range of Service

THE greatest need of the amateur mechanic, especially the man who wishes to do machine work in his

home or garage, is proper muchine tool equipment. No one can build models out of rough east material or do any considerable amount of metal work without the aid of machinery to turn, bore, drill and ream. Although such work can be done in local shops, the costs mount so rapidly that usualy it does not pay. Therefore, in planning his shop, the amateur mechanic always figures on installing a small lathe, a senative drill press, a tool grinder, and other machine tool equipment. Meager as this installation may be, it costs a relatively large amount and frequently. for want of so much cash, the home worker shelves the idea and, in consequence, the shop does not materialize

On the other hand, the home machinist would gladly undertake to build his own equipment if he knew how to start. And that is not so difficult as it appears, especially if the first tool built is a sample maBy Joe V. Romig



chine of wide utility, like the one illustrated. it then can be used for machining the parts of more complete and complex ma-

Because of its general utility, the writer suggests that this muchine be called the

"Universal." It combines come of the features of the drill press, horizontal horing machine, miller and lathe, all in one enally built machine.

The rugged head runs on one slide that can be set at any angle on top of the work plate. The head can also be set in two positions on the slide. A 12-hp, motor is sufficiently strong for driving the muchine. The countershaft is nothing more than a drum mounted overhead on bearings made from pipe fittings. The bed ar work plate is cast in good gray iron from a simple pattern. Machined true on its top face, it is laid out and drilled for the 34-in, tapped holes, which are spaced \$ in. spart, as shown. These hules should be countersunk prior to tapping, to prevent the possibility of

raising a burr in threading. The plate also m se a surface plate for laying out Work.

The slide of the machine is built of fint cold rolled steel, the top and lower plates (Continued on page 111)

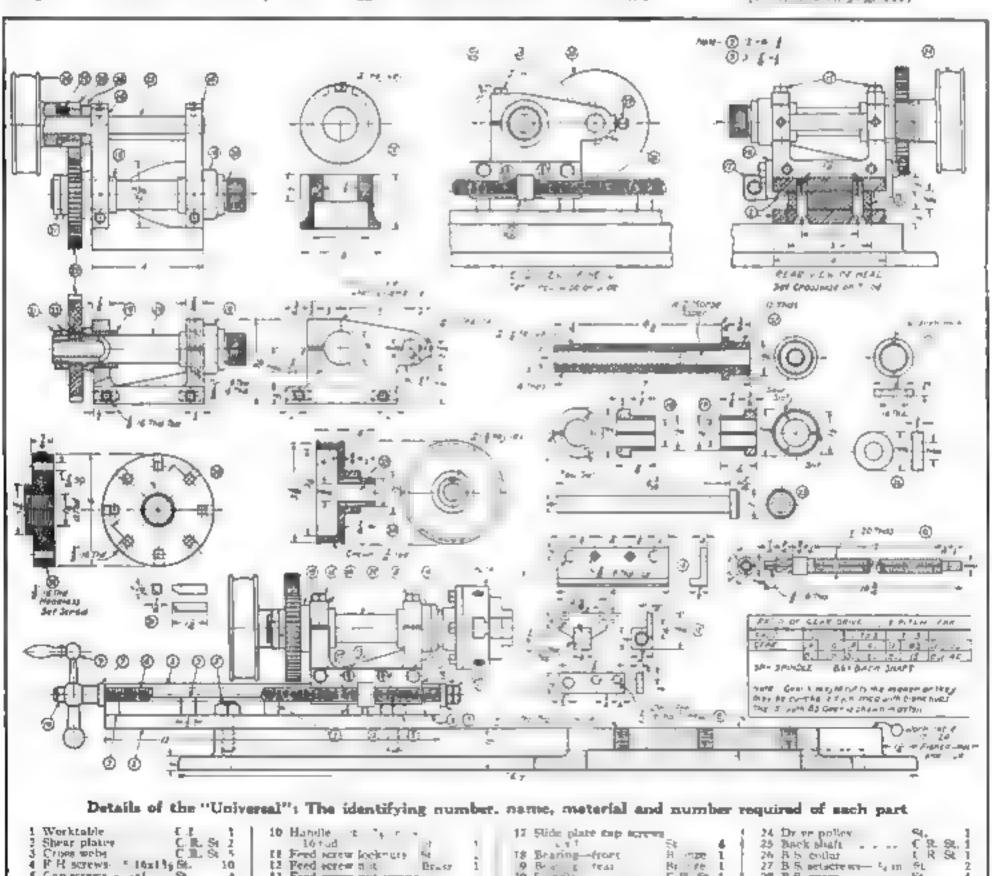
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What every man wants in a shotgun powder is given him in "Du Pont" and "Ballistite".... that means confidence—and that means a full game bag. Is that not reason enough to look for the name on the carton and top shot wad?

SHOOT DUPONT POWDERS



Better Shop Methods

How Expert Mechanics Save Time and Labor

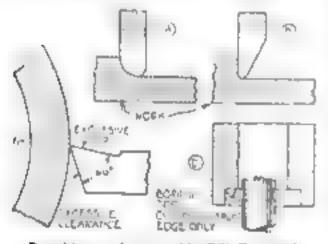


How Do You Grind Your Tools?

BILL, ran the shop's big 10-ft boring mill, a husky, motor-driven brute of a machine. Yes, he ran her. But how? Tom, a young high school grad, was running the 8-ft. mill. Skelly, the lad across the nisio, operated the 60-in. lathe, the biggest lathe in the shop, and he ran it well. Shorty, although a floor hand, was called to the 48-in planer when work on the floor was slock. Harry, the crack lathe hand, was running an old tool lathe of 18-in swing; Luther, his buddy, was knocking around the shop as an extra man, working rush jobs on machines left vacant by sick or absent operators.

The first day I started to work in this particular shop, I met each of these men, who with others operated the machine tools in a foundry and machine manufacturing plant. I soon came to know them as representing various extremes in their practice of tool grinding and tool usage.

Every machinist has his own ideas of what constitutes a perfectly ground tool, and no two men either grind or use their tools alike, unless educated to a single correct standard. Even if the finished work



Roughing tools ground by Bill, Tom and Shally are shown at A, B, and C Luther's boring tool is disstrated at D

of different machinists will interchange and pass the inspection standards, the cost of

the work varies with each operator because of the way he handles hts tooks. Indeed. the difference of opinton in regard to the proper grinding of tools and their most efficient usage is exceedingly coatly in the long run because of broken and burned tools, excessive power consumption, wasted time.

Testa have been made by all the well known tool steel companies to establish the best angles of lip, rake and clearance, and these findings are available to almost any mechanic in the public libraries of his

By Joe V. Romig



city or town. Any mechanic who has not passed the "learning age" will quickly understand the theory and reasons for the best systems of tool grinding if he will take advantage of these researches, and that knowledge will make him a more accurate and rapid workman and also will save him effort and worry.

Bill had been running his particular horing mill for the past five years. In fact, I was told that he had set her up on her foundation when the company bought her, and he was still using his original set of 1½ by 2-in, tooks, many of which were so short and atumpy that only one setscrew in the took head could be used to clamp them. The tooks simply reflected Bill's shiftlessness and neglectfulness.

All of Bill's round nose roughing tools were ground with a great, wide, gweeping radius so that when cutting to a depth of only 14 in in a steel casting, they would

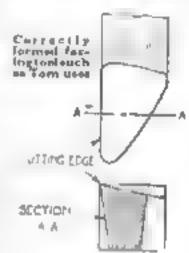
throw a chip an inch in width. One can well imagine the extra amount of power required by a tool having so much bearing on the cut. It was funny, though, that when the manager brought visitors through on a tour of inspection, he always stopped at Bill's boring mill and called attention to the big black and blue chips that fell from Bill's blunt "metal pushing tools," as we had hamed them.

Many a time have I heard the old heavy duty motor with its geared drive grean under the strain of shoving Bill's blunt nose tools through a gate or riser on a heavy casting and expected to see it go up in smoke any minute, since Bill, as might be expected, had all the juses plugged in his starting hor

Tom, the youngster who was in the last year of his apprenticeship, had his tools as nearly perfect, both as regards theory and practice, as one could wish. It was a real pleasure to see the chips fall from his coughing tools on either steel or iron castings. Compare Tom's type of roughing

tool fi) with that used by Bill (A) and take your choice.

Tom had read up on the design and grinding of tools and was instrumental having changes made in the system used in the redressing department. His roughing tools were either rightor left-handed,



and were not compromises that could be used either way, such as many that the other chaps were using. Tom's chips were equal in width to the depth of the cut, and he always run his machine and tool

equipment at its most efficient speed. The atcel chips fulling off his roughing tools were a dark brown color Torns theory was that a bius chip was too hot and would cost more in the end for power and toolsharpening than a brown chip, but the bosses admired Bill's blue chips more than Tom's brown ones.

Skelly, a big excoalminer, on the 60 in. lathe, believed in plenty of hip and clearance. He wanted his toom to work freely and to have plenty of room all around. His idea of a (continued on page 84)

"How I Got that Better Job"

Announcing \$60 in Prizes for Stories of Your Personal
Experiences in the Shop

EVERY machinist and other mechanic has had experiences that parallel those Mr Royal describes in this fascinating narrative. Mr Royal's article is ideal for the Better Shop Methods Department. We want more articles like it.

Therefore we are offering a first prize of \$30, a second prize of \$20, and a third prize of \$10. For the three best contributions or letters of this nature, submitted on or before February 20, 1923. Contributions may be any length up to 3000 words. Others than the prize winners may be purchased at space rates. Fencil drawings should be used to explain obscure points, and if

photographs are available to illustrate the article, they also should be included. The subject must relate directly to better shop methods, and be told as a first person narrative of shop experiences that may help or stimulate mechanics to achieve better workmanship through improved methods or the application of novel ideas.

The context will be judged by the Board of Editors of this magazine, and amouncement of the prize winners will be made in the May inside.

Address contributions to Better Shop Methods Contest Editor, Popular Science Monthly, 225 West 39th Street, New York City. SIX SENSES

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THE SIXTH SENSE OF INDUSTRY

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WHERE molten metal runs and splashes like milk - where the fierybroth shifts its flame-tints through violet, grange, pink, white and blue as it is "seasoned" with carbon, ferro-manganese, tungsten, ferrosilicon or vanadium—the practice to years gone by was to gauge the proper pouring temperature by observing the colors with the naked The expert peered into the maw of that inferno, protected by colored glasses, and when he judged the time was ripe-out leaped the frenzied stream into the incandescent ladles! The result might or might not be good steel, of the proper grade for the purpose intended.

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Figure 541

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BETTER SHOP METHODS

How Do You Grind Tools?

(Continued from page 80.

perfect roughing tool C was one in which the included angle of a tool's cross sect on, when viewed sideways, amounted to 60 degrees. He was a stickler on the redressing of tools and was known as "the pest" in the smith shop.

Skelly's idea was to make one big, beavy, rough cut, run at alow speed with a heavy feed-let her rip or bust. Many a time we marveled that his jobs stayed between the centers, with the tool, its front edge worn off, acreeching a protest. After a readjustwent of his centers and a fresh oiling. Skelly would put in a newly sharpened tool, speed up a bit, and knock a few notches in his ford. He was a genuine producer because of his tool and machine operating experience bia bordness, and what the boys called his "fool luck " A.though he drew better pay than the average, he worked only half as hard as many on arrailer lathes, his motto being, "Let the machine do the work."

Shorty, the "blatherskite" by nickname, could be heard all over the abop at almost any time of the day, and so, too, rould be heard his tools. If they were not acreeching, they were chaitering, just like the manhimself. Shorty could make a tool cut even if it were ground with a negative clearance and no lip at all. Many a time have I seen. him shim up a tool to give it the necessary clearance barely to cut. His idea seemed to he to do as little as possible and never more than was absolutely necessary to hold his Job. His tools never needed redressing and seldom required regrinding, as they were always run under the most conservative speeds and feeds.

These Men Know Their Tools

Harry, the best of the lathe operators. was running an old tool lathe, most of his work being on tools and jigs. He had the largest assortment of tonis in the shop all in perfect condit on well sharpened, ready for mutant use. He hated to dual a too, on a rough job and invariably advanced the argument that a better job could be made if the roughing was done on some other fellow's lathe. No man could horrow his special form of threading toom and consequently they were always in the pink of condition. Although he did beautifully accurate work in a reasonable time, he was thought to be a trifle too fursy

Luther, the all-around man, could use any man's tools and make them work; he just ground them to suit his own taste. He could do a greater variety of work with fewer took than any other man in the shop. For instance, he could true up an eccentric bore quicker than any of the rest of us. The cutting edge of his boring tool Do stood at right angles to the central axis of the bore of the bushing. Thus when the heavy strain of the eccentric cut came down upon the bar, it merely depressed a trifle, and did not shove away like the tools used by the rest of us, who always thought a boring tool should be well radiused off

The day I went into that shop and saked for a 10b as machinut, the red-headed foreman anapped, "Well, what can you du?"

"Oh, almost anything in a machine shop," I replied.

"You can, can you?" be shouted, above the din. "Ever run a lathe or a boring mill? Say," he continued, 'can you sharpen a tool? Here, take this roundnose

. continued on page 83.

BETTER SHOP METHOLS

How Do You Grind Tools?

Continued from page 82,

over to that wheel and let me see what you can do to it."

Returning in less than a minute, I handed him the tool, ground in my best style. He then barked, "Give you sixty an hour. When can you start?"

Later on this little red-headed judge of mechanics was forced to resign because of il. health, and it was he who recommended me as his successor

Boys, how do you grind your tools?

How Cutting Tools Act

REMARKABLE pictures showing the stresses to which machine tools are subjected in use will be published in a forthcoming number of Porular Science Monthly. The photographs were taken by so-called polarized light, and the beautiful color effects made by tools cutting into the work indicate graphically just how the stresses are distributed. This is an article no mechanic should make.

Improved Planer Gage for the Machinist's Toolkit

EVERY much cost will find it worth while to add this planer and shaper gage to he too ket. It has an end alice, as well as the regular alide, and both alide blocks are tapped for height hocks. This permuta the gage to be used for two measurements at once and gives than unusually wide range.

Complete working drawings of the tool are conto red in a bluepoint prepared by the Better Shop Methods Department. This can no obtained for 25 cents by filing out the coupon below. The blueprint also shows an optional



Details of this timusually fine tool gest contained in Blueprint A, prepared by the Better Shop Methods Department

scriber attachment that allows the tool to

be used as a height gage.

A feature of the blueprint that is of particular interest to technica, high schools, vocational schools, and other schools where machine shop practice is taught, is a series of thumbnail sketches that show how the work is laid out and the main operations performed. The making of the gage is an excellent project for such schools because of the accuracy required and the utility of the finished tool

The slots are first sawed and then milled with a T-cutter after the work has been set parallel on the milling machine with the aid of an indicator. After the piece is pack-hardened, the alots are ground to size.

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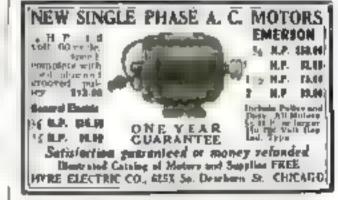
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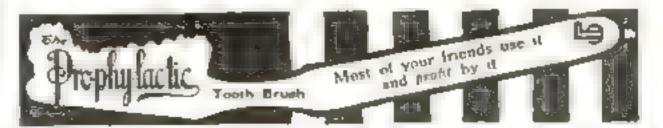
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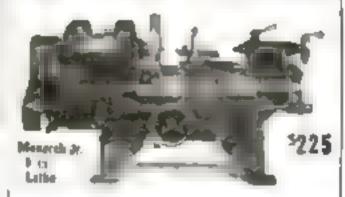
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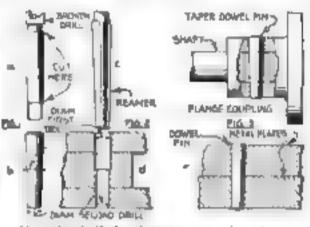
THE MONARCH MACHINE TOOL CO.

BELLIER SHOP METHODS

Shanks Salvaged from Broken Drills Serva Many Purposes

THE shanks of broken or worn-out twist dries may be salvaged and used in many ways in the machine shop or factory A number of the possible ways of using them are disastrated below.

Figure 1, a, shows the part of a taper shank utilized as a dowel or taper pin. To avoid excessive wear on the reamer in finishing the holes for these pins, two holes should first be drilled, one the diameter of the pin at its center, and the other the diameter of its small end, as shown at b.



flow the drill shanks are out and various uses to which they may be applied

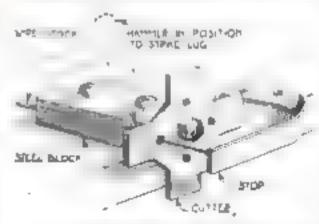
The larger hole is drilled halfway through from one side, and the smaller hole is then drilled through the rest of the way, so that there will be a minimum amount of metal to be removed by reaming.

When this has been done, as illustrated in connection with the metal lamination shown at d, Fig. 3, a reamer of the correct size, c, is used to finish the hole. Figure 3 shows a shaft and flanged coupling held together by the shank of an old drill, and at f are pictured two plates bonded together with a similar pin,—Fixp 8. Hanger, Terre Haute, Ind.

Hammer Blow Operates Wire Cutter for Radio Work

Tills wire outler was devised in a Washington, D. C., shop that is constructing radio equipment. It consists of a steel block, attached to one end of which is a cutter which has four projecting lugs and four cutting holes. The lugs serve as striking faces for the harmoner

As the stock is pushed through one of the cutting holes, it strikes either a fixed or an



A time mying fixture where much wire cutting must be done

adjustable stop, as required. The cutter is then struck with the hammer to sever the wire. The end of the remaining wire or rod catches the next opening so that the operation may be repeated.

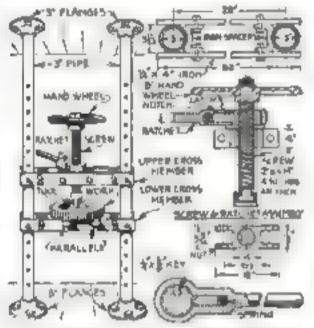
This is a simple device and for a hand operated tool cuts the stock quickly and smoothly.—F L. M

BETTOR SHOP METHODS

Easily Built Press for Garage Handles Wide Range of Work

ONE of the most essential tools in the garage is a press upon which tight gears, sleeves, bushings, and the like can be set in place. In order to handle a large variety of work, the press must be quite large. The trouble with many commercial presses is their short vertical range

The cheap and rugged press that is illustrated has a wide range and can be built with little difficulty. The main standards are 3-in, heavy pipe fastened to both floor and ceiling with 8-in. floor flanges. The pipes are drilled as shown for pinholes before assembling. The standards should be plumbed carefully when they are put in place. The cross members are built up of 14 by 4 in, bars of flat iron, which can be obtained from any hardware store dealing in blacksmith supplies. Iron spacers can either be bent up out of flat iron or castings made from a simple pattern. Those hold



This sturdy proce, with its pipe standards and simple parts, can be built at small cost of materials

each pair of cross pieces apart the correct dutance and also form a rough bearing that sides against the uprights. They are fastened to the cross pieces with short by-in hours.

At the center of the upper cross piece is the nut, fustened with bolts that run clear through the whole assembly. This put should be a bronze casting, sithough an iron nut can be used. The server is turned up from good machinery steel to the size shown. The bottom end carries a swivel foot that remains stationary when the screw turns. Between the end of the screw and the inside swivel block should be placed a bronze disk to take up the pressure and allow the screw to turn freely

The screw is turned by means of a ratchet device, illustrated in detail. The power applied to the handle is transferred through the slotted bushing and a key to the screw, as shown. The hand wheel on top is for setting the machine quickly and can be used for work that does not require any great pressure.

The ratchet, which works only in one direction, can be thrown out of action by pulling the latch back and turning it into a slot. This allows the screw to float free from all the parts. Parallels of square steel are used to support the work.—R. J.

WHEN tempering work to a light straw color, always have a brightly polished piece of steel for comparison, so that the eye notices the least change in color



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The prettier teeth you see everywhere now probably came in this way.

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Dentists, the world over, have declated a war on film. That is the cause of dingy teeth—the cause of most tooth troubles.

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Persodent also multiplies Nature's great tooth-protecting agents in the mouth. One is the starch digestant in soliva. That is there to digest starch deposits which cling to teeth. In fermenting they form acid.

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One week will convince you that Pepsodent brings a new era in tooth protection. Then show the results to your children, Teach them this way. Modern dentists advise that children use Pepsodent from the time the first tooth appears.

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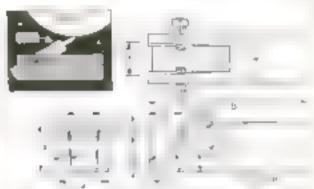
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THIS tool holder for grinding threading tools on a surface grinder is so simple that one can easily be made in half an bour It holds the tool in such a way that not or , is the threading angle properly formed, I it



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the correct clearance is provided at the

One setscrew is used to clamp the tool when one face is being ground, and the other when the opposite face is presented to the wheel. The setserew not in use as withdrawn far enough to permit the tool to be that against the surgice of the energy factor.

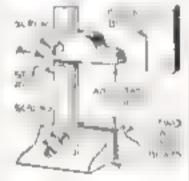
Another selscrew passing up through the " trom of the helder makes it possible to set angles other than 60 degrees, -B. L. R.

Bench Height or Sizing Gage Serves Many Purposes

SIMPLE and effective sizing gage is A shown in the illustration. It commes of two cast from blocks between which goes a regular scale, or, if preferred, a piece of steel marked of to serve as a scale. It will

be noted that the scale is fastened to the two blocks by two flat head serowa. A ninng member A in held by a small serew at any position

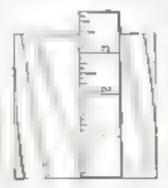
Thus type of height gage to particularly usefal where numer-



our pieces have to be inspected as to height and wid h. In order to make sure no ar accuracy takes piace during use, commercial gages can be used, or check blocks of the common heights can be made. Thus after expedient, however, is only for very particular work .- J. M.

Finding Lead of Spiral Cutter

TO FIND the lead of a sparal making cutter, place the cutter on the markingoff table or surface plate and apply an ordinary scale, as shown. Pace the scale at the end of one tooth and note the distance where the edge of the scale cuts the



line of the next tooth. Multips this distance by the number of teeth and it will be very close to the lead

The sketch shows a lead of 30 in figuring 8 in. for one tooth for a ten-tooth spiral -F H SWEET

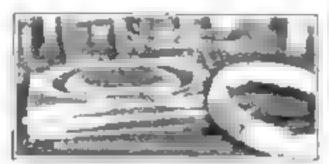


BEITER SHOP METHODS

Heated Resistance Coil Quickly Dries Sand Molds

A RESISTANCE coil provides a quick and inexpensive method of drying and molds just before pouring in the mosten metal. The moid illustrated was used for casting a ring from an alloy composed of 80 per cent nickel and 20 per cent chromium metals used for the heating element in nearly all electrical heating devices

A 1/2-in apira, of No. 16 nickel-chrom um wire was cut the right length to fit the



Mold is heated by electricity instead of

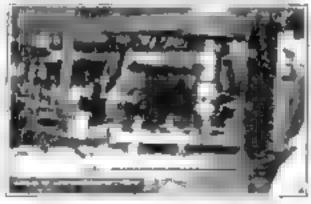
depression in the mold and connected with lamp cord to an ordinary electric-light socket. The depression in the mold is 6½ in deep 5½ in across the top, and 44 in in outside diameter. If a stock of resistance who is kept on hand, it can be made up into ½, ½, or 1-in, coils at odd times and these can be cut to a length that will fit any size

or shape of moid.

The coil is simply dropped into the depression, the electricity turned on and the mold covered with firebrick to confine the heat. The advantages over the method of baking molds in overs are that best can be applied directly to the casting surface of the molds; no heat is wasted in drying out the parts of the mold that are not required wooden flasts and bottom boards are not dried out and burned; savings are effected in the labor and time of carrying molds to and from baking overs, and the mold can be kept hot until the moment the melt is to be poured.—E. F. Lake, Detroit, Mich.

Quick Change Milling Machine

TO THE end of a regular milling machine appendix an ordinary 8-in, pulley (A) was fastened. In the hole usually occupied by the overnom was placed a bracket carrying two idler pulleys, one of which is shown at 8. A vertical spindle (C) was supported



Vertical spindle on horizontal miller

on the regular overarm of the machine. This vertical splindle had a pulley (D).

The main belt drives the require spindle and this turns pulley A. The extra belt fastened around A and over pulleys B, drives the pulley D.

The complete outfit, costing \$10.50, can be changed from horizontal to vertical or vice versa in 10 minutes. - I H MOORE



"WANTED— Some jobs for this screw-driver"



Ratchet Screw-Driver

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Under this screw-driver, screws go in like magic. Hard or soft wood—it makes no difference to this tool. It has a reputation for strength, durability, and convenience among men who appreciate good tools. It feels like a good tool, acts like one, and soon proves its worth.

The ratchet mechanism is a timesaver. It can be set so that the blade turns only to the right or to the left, while the handle revolves freely. Blade and handle can also be kept rigid.

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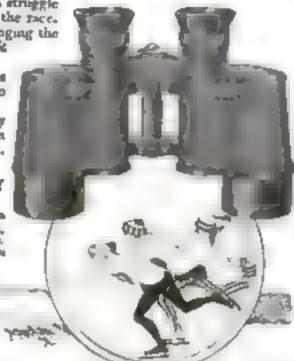
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BETTER SHOP METHODS

Heavy Pipe Used as Mounting for a Fixed Vise

AN IMPROVED method of mounting a vise for general purposes in the shop is shown herewith. * The pedestal is a short length of 4-in, wrought from pape, with two finness. One of the finness is builted to the

floor, while the other forms the supporting face for the vise.

The advantage of the year in that the mechanic can work without restrictions on al sides of the fixture, in the most convenient position and the best light. Where hammering or riveting is to be

done, the metal base affords a more rigid support than if the vise were mounted on the top of a wooden bench.

WITHOUT

SW YEL

BASE

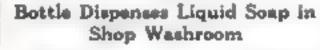
sturdy pedestal vise

4" PIPE

FLOOR

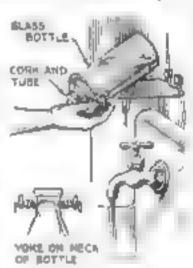
FLANSES

Apart from these advantages, the mounting is relatively inexpensive to install .- A. J.



LIQUID coap dispenser suitable for the shop washroom can quickly be made from a short bottle of as large a diameter as can be found. The cork is pro-

vided with a apout made from a short tube. A yoke of wire in then twisted around the neck of the bottle and mupended from a at if wire bracket attached to the wall above the faucet. The yoke pivota in such a way that the bottle normally hange upright and yet



For suap colutions

can be tipped over readily by pushing against the lower part with the tips of the fingers.

Liquid soap can either be purchased or made by shaving up brown soap and dissolving the alices in bothing water. - E. L. F.

Stiffening Universal Wrench Joint

WHEN oocket wrenches with a univercal joint are new, the friction between the parts is sufficient to make a connection that will remain stiff when the wrench is being used. When the wrench be-

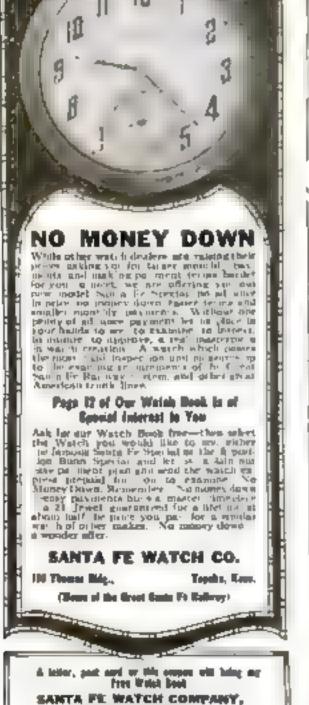
comes somewhat worn, however, the joint tends to loosen and the

LIGHT COIL SHIPS Sering holds joint firmly

To avercome this objectionable feature and yet allow the joint

socket wabbles

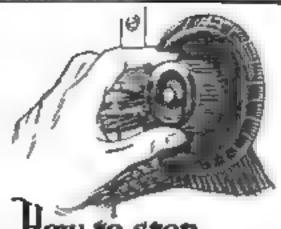
sufficient flexibility to serve its purpose, it is necessary merely to place a light collapring about the parts, as illustrated. One and of the spring is attached to the wrench handle so that it will not slip off .- G. R. Y



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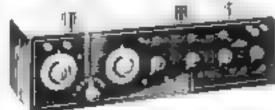
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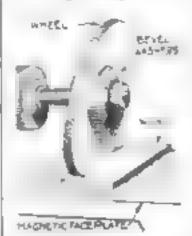


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Write for cetalog CROSLEY MANUFACTURING COMPANY CINCINNATI, OHIO BETTER SHOP METHODS

"Wabble" Wheel for Surface Grinder Prevents Glazing

"RE "wabble" saw for increasing the width of cuts is an old idea that has increased production in cutting slots and key seats and doing other work on the milling machine without using the transverse feed on the table. Following this same plan, a wabble wheel on a surface grinder has recently been tried in a large muchine shop for grinding the surface of steel instrument springs. The results proved to be nnegpectedly favorable



Beveled retaining plates such as are used for the circular steel saw, hold the abranye wheel on the mandrel The wabble or offsot corresponds with the width of the material to be ground, or alightty in excess of that. The fore

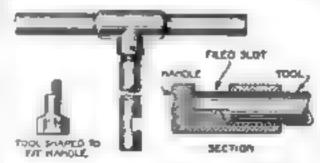
and alt movement of the machine table is not used, as ordinarily, and the material is fed slowly forward, the entire surface grinding being accomplished by the work passing only once under the wheel.

In this work the wheel holds up as well as it would do when running true. A noticeable feature was the absence of glazing on the wheel surface. The fanlike action of the wheel keeps the heat down and permote a beavier cut to be made than was possible with a true wheel. By making a comparison between the costs of production before and after the wabble wheel was used, the saving in time was found to he about 25 per cent .- P L. K.

Broken Tools Saved by Means of Detachable Handle

DETACHABLE handle for many tools A can be made very simply by the method illustrated. This consists of drilling into the end of the piece of steel selected for the handle a circular hole and fling just at the end of this hole a gross plot half through the section, as shown

To prepare the tool for this handle, it is necessary only to file or grind a half see-



This simply made handle gives considerable lavarage for according and other tools

tion at the end. When the tool is inserted. in the socket, the end lip seats on the shoulder and forms a firm bearing for holding it.

Broken tools, such as socket wrenches, drills and acrewdrivers, can often be salvaged by this means. The fact that the handle is detachable is an advantage because it can be used for several tools, and the work of making it up requires only drilling and filling.-M. R. C.

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By L. P. Reifein



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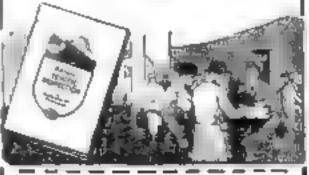
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Will There Be a \$150 Car?

(Continued from p. g. 21)

tools and manufacturing processes. Special machines have been designed and redesigned to turn out parts at great speed. The latest drill press drills 100 holes at once. A dozon flywheels are finished at a time. Year by year, as improvements have been introduced, the price of Fords has dropped. Is it not reasonable to essume that manufacturing processes will continue to improve as they have in the past, resulting in still greater production and still lower prices? Certainly the suggestion that the \$150 car will eventually be produced by Ford, Durant or some other maker sounds fully as reasonable as did Ford's announcement in 1907 that he would build a four cy arder runahout

The \$150 car, when it arrives, cannot be noticeably smaller than the present Ford or Star, but it certainly will be lighter. One thousand pounds is a logical weight. In design it will not be radical, although short cuts in arrangement of paris will keep the weight down and lower manufacturing expense. In Europe cars within this weight limit are now being built to carry three or four persons. These cars are untatually small, yet most of them are well equipped with four cylinder water-cooled engines, clutch, three-speed transmission, electric starting and lighting. The engines have a hore of from two to 212 inches, a stroke of from three to four inches and they develop from 10 to 20 horsepower.

Some Features of "Every Man's Car"

The rapidly increasing popularity and practicability of air cooling indicates that thus form of cooling would be used in the \$150 car. Other funtures of the 'every man s car," as I picture I would be a wheelbase of 100 inches, a trend little less than standard, 28 by 8 tires, a four-cylinder engine of 2 by 4 Inch inside cylinder meanurement and cooled by hinwer and air (ackets, spinsh lubrication, clutch, and two speed transmission,

The engine would develop about 15 horsepower, propelling the car at a speed of more than 40 miles an hour. It would run 60 miles on a gallon of fuel and 1000 miles on two quarts of oil. This oil consumption is figured on the plan that the erankesse would be drained every 1000 miles and filled with new oil

A car of this design should run 10,000 miles on tires that should cost no more than five dollars each. If appearances were no object, tires smaller than the 28 by 8 eine would be sufficient for a 1000-pound car. The complete cost of operation, including depreciation and repairs, would be just a trifle more than one cent a mile-1 27 cents to be exact. The expense items on a mileage basis would be: gasoline, .5 cent; oil, .05 cent; tires, .2 cent; repairs and depreciation, .516 cent.

To minimize cost of units, side frame members, runningboard, and runningboard. aprons might be combined into a single unit. Body sides might be designed to take the place of the frame; the hood, cowl, and false radiator might be pressed from a single sheet of metal, access to the engine being obtained by lifting the entire cover-

ing unit from the front. Certainly the practice of placing a conventional hody of sheet metal on a carefully built frame would be discarded, possibly in favor of a

body of compressed cotton and glue such (Continued on page 91)

Will There Be a \$150 Car?

(Continued from page 90)

as Ford is experimenting with. Floors would be of wood, the windshield a single piece of glass, and the top designed possibly along the lines of a seasbore umbrella. Dark wheels of a single sheet of metal would be used. Various parts forming the body would be ename'led as manufactured so that the car when assembled would not require painting

The power plent and all its adjuncts would form a single unit, the engine being so small that a kick starter like that used on a motorcycle would be sufficient. The storage battery, generator and gasoline tank would all be in unit with the engine Thus, when repairs were required, the nuts holding the engine to the chases would be removed, the universal joint disconnected, the hood tilted back, and the engine would be lifted out easily. A very small storage battery would be sufficient because of the comparatively small lights and the climinution of the starter

That such a car is a future possibility at a price of \$150 is proved by comparison with the present Ford. The Ford runabout retails at \$269. The average Ford dealer buye it for about \$228. From this figure deduct the manufacturer's profit and taxes which, according to most recent statements, amount to \$69. Thus the net cost of manufacturing is \$159, or about 10 cents a pound. figuring the weight at 1600 paunds. On the basis of the same manufacturing cost a pound, the total cost of the \$150 car, weighing 1000 pounds, would be \$100, leaving \$50 for sales profits and expense.

Where Savings Might Be Made

Indeed, it is very probable that the cost a pound could be reduced below that of the Ford by important savings. The engine of the \$150 car, for example, would require only one third the machining that a Ford engine does. The cost of a small generator and battery could be balanced against the cost of the Ford magneto. The body and top construction would be simpler. There would be only seven gears in the transmission se compared with 12 years in the Ford transmission. The Ford has a multiple dak clutch that well might be replaced by a single disk clutch. Three Ignition calls could be discarded.

Figures on the possibilities of quantity production are even more inviting. Assuming that the low price of \$150 would be attractive enough to create 20,000,000 new car owners and that the average life of the car would be four years, continuous production at the rate of 5,000,000 machines yearly would be possible. And such an naturation is not an exaggeration when we consider the fact that of the 110,000,000 persons in the United States, 10,000,000 already own cars. After 20,000,000 new owners were supplied with cars, an annual production of 5,000,000 would be required to replace worn out machines.

With the assurance of such tremendous production and rapid turnover-the \$150 car would almost certainly sell itself over the counter, and present expensive selling methods would no longer be required the margin of \$50 a car for grees profits and taxes, siready mentioned, should be entirely adequate for the manufacturer

Systematic salvaging of "worn out" cars would be possible. At present only about 26 per cent of a car that is junked is really

(Continued on page 102)



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Home Workshop

Continued from page 78,

Snug Log Cabins and Bungalows

DURING cold weather to

build log shelters, because then the sap has retreated into the roots. Any soft wood trees with straight trunks may be used, but the best are spruce, balsam, proc, hemlock, fir, tamarack, and poplar. The

most convenient sizes range from 8 in. to 1 ft. in diameter

There are four types of log shelters that may readily be constructed. The most simple is the shack, usually with one room and no chimney or porch, small and built solely for protection against the elements. The logs stand vertically and the roof

in peaked. The log cottage is a little larger and has a chimney and fireplace, a gable roof, and a porch. The logs may be either upright or horizontal or the walls vertical and the gable ends horizontal, or vice versa.

The log bungalow is ordinarily a warm weather abode, usually with dormer windows in a roof of peaked or hip style and large porches. The true log cabin is built ordinarily with borizontal logs and the roof is of the leanted type

Few tools are needed to build a simple log shack or cabin. An az will de all the cutting, but a buck- or hand-saw will make the work easier for the amateur. A 2-in, chosel will eid in making mortue and tenou joints, shaping notches, and fitting door and window frames. A single bit az is the handlest because it can be used for pounding pine lute place A crosscut saw will help in felling very large trees.

The most popular foundation is made by resting the sill timbers upon cedar posts that extend into the ground 2 or 3 ft

The sills may talely test directly upon rocky ground or hard clay, or large stones may be placed at the corners and at intermediate distances under the siles.

When the silis have been cut, chop two opposite faces flat like a railroad tie, saw off the ends at a bevel of 45 degrees, and spike together upon the foundation. The method of securing the sleepers from aill to sili is shown in Fig. 1. They are placed every 3

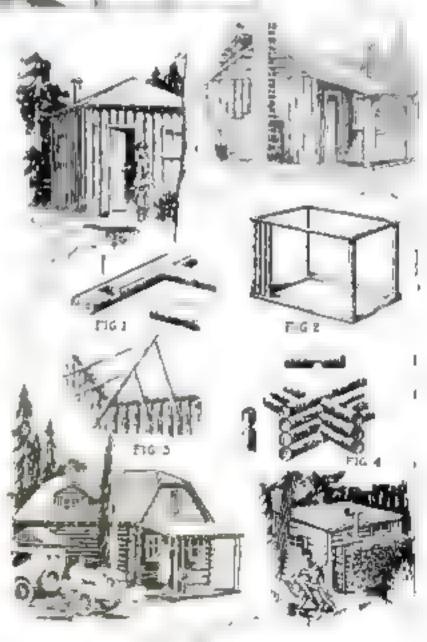
By F. E. Brimmer ft. for a board floor and 4 ft. for planks.

The log frame of the typical small Adirondack shack is shown in Fig. 2. Four corner posts 6 or 7 ft. long are toe-spiked to the sills and then plate logs are spiked to the tops. After this the wall logs are cut

to the proper length and spiked in place between will and pute.

Fig. 3 shows the method of building the roof. From each curner a beam extends to the peak, and each rafter, where it fits over the plate log, is notched and spiked





Four typical leg shelters and details of construction

in place. The small jack rafters are spaced 2 % ft. spart along the plate. Cover them with 1-in. boards and shingle the roof or lay heavy roofing paper.

In case a cabin with horizontal logs is built, the corners should have the notches downward to shed the rain, as shown in Fig. 4.

To fill the spaces between the logs, cotton waste or cakum should be pounded into place with a mailet and blunt stick.

THE HOME WORKSHOP

Building an Ideal Bench

(Continued front page 75)

the separate pieces were given to the mill to cut the stock to dimensions. Since maple is exceedingly hard, it is not advisable to attempt to saw it by hand. If maple cannot be obtained easily, beech or birch will do very well and other hard woods may be used, although maple, beech, and birch are

practically standard for bench tops. An excellent methad of making the top is to use a number of parrow tongued and grooved strips bolted together, but a well-seasoned, solid plank will serve every purpose and does not require so much work to pre-



Adjustable and remps able bench stope

The framework is fastened together with lagacrews or holts. The back portion of the top, containing the recess, is attached as a unit to the solid plank in front by lagacrews and dowels. The lagacrews pass through the end blocks, which are bevelled so that chavings and dust may readily be swept out of the depression

The 214 by 214 in, muntim between the drawers and the small door at the left are lagscrewed to the front rails at the top and



bottom, the heads of the lagacrews being sunk into the top rail. The top is attached either with 1/4 by 4 in. lagacrews, through the rails from underneath,

with the heads countermank, or by means of blocks screwed to the inside of the rails and to the under side of the top.

The frames for the drawer slides and guides are glued together square and put in (Continued on page 94)

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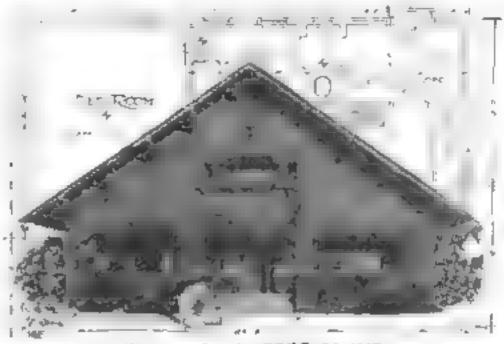
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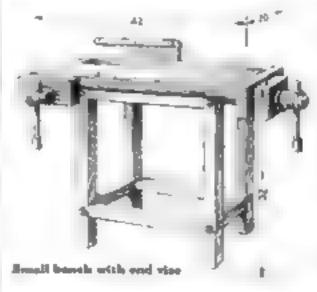


Building an Ideal Bench

(Continued from page 93)

place as the parts of the bench are bolted together. The \$5-in, kinings at the sides of the lockers are screwed to the frames and the bottom drawer runs before assembling so that in case it is ever necessary, the bench can readily be "knocked down" for moting

The door of the end tool cabinet is fitted with a chest lock, as this type of lock can be purchased at any hardware store, but a lock or catch of other varieties can be used if preferred. A permanent bench stop, preferably an adjustable metal one, abund he provided, as well as a removable stop to fit into mortises cu' in the bench top as shown. The adjustable stop can be raised or lowered to suit the thickness of boards that are being planed, acraped, or sand-papered. The removable stop can be alipped into any one of the holes, which



should be 7a by 1 in., 34 by 34 in., or 54 by 44 in., according to the stop. It is advisable to buy one before cutting the mortises, since the stops come 3a by 34 by 54 in., 3a by 3a by 4 in., 5a by 1 by 71a in., and other since

Stetal woodworking vises can also be obtained in many styles and sizes, one of which is illustrated

The bench should be finished with two or three thin costs of sheliac or rubbed with genuine boiled linseed oil. Sometimes commercial benches have an oil finished top and sheliacked frame, and this combination can be used if preferred. Although benches are almost invariably finished in the natural wood, occasionally fine benches and tool cabinets intended for use in the home are stained.

For one who already has a toolchest or tool cabinet, the drawers and lockers probably will be unnecessary and they may be on ted and left to be installed at a later date when new tools make necessary an additional storage place. Other modifications may be made, such as omitting the drawers and lockers, or making a large locker on h double doors in the space occupied by the three drawers.

A bench of a sampler type is the one shown above with two vises. It is 42 in long, 20 in, wide, and 32 in, high—somewhat smaller than the cabinet bench. It is bolted together, the nuts of the bolts being inserted in large holes bored in the rails so that they can be held firmly while the heads are turned up with a socket wrench. The wooden vises are considerably cheaper than quick-acting metal ones. The extra one

(Continued on page 95)

Red Devil

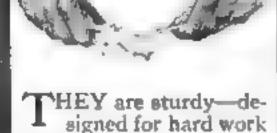
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THE BOME WORKSHIP

Building an Ideal Bench

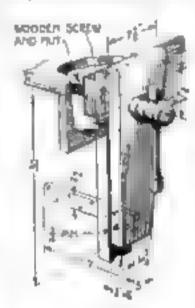
(Continued from page 94)

at the end is useful in cabinet work and serves as a substitute for the regulation end vise found on cabinetmakers' benches.

Another simple bench to build is the small carpenter's bench shown in the lower ight-hand corner of page 75. This has an old-fashioned vice, which really is a very useful and sturdy vice for general utility work because of its size and wide range. All that has to be purchased to install such a vice is what is known as a wood bench acrew, a wooden vice screw, a wooden or metal nut, and a wooden vice handle. The screws are usually either 2 or 2 15 by 24 in

The method of making up and attaching the vise is abown in detail. The arm at the lower end is a aliding fit in a mortise in the

leg of the bench. or in a block attached to the leg. Apin or peg -- в 20-реплу ob Liw tran nicely - la pushed through one of a series of holes to adjust the arm according to the thickness of the work that is to be clamped in the vise. If, for ingtones, a box is to be held in the vise, the brm is pulled



A wooden vise

out the distance necessary to allow the vice jaw to remain parallel with the apron on the bench. This apron should be 10 or 12 in, wide and have holes hored at regular intervals in it to take pege used to support one end of long plants being planed or otherwise worked.

Better than this bench for fine cabinet work is the professional cabinetmaker's bench, also illustrated on page 75. This is a long bench with an L-shaped and vice

If no room at all is available for a beach, a beach attachment may be made for the



A discarded bedstand provided the legs and lower rails of this bouch made by Herbert A. Mancher, Youngstown, Ohio

kitchen table (see the illustration in the lower left-hand corner of page 75). This is merely two planks accewed together at right angles to each other, as shown.

A block with a V-shaped notch is acrewed to the top to serve as a beach stop and a vise is attached to the apron as shown.

The attachment can be stored in a closet or behind a door and when needed it is simply placed on the kitchen table and held with a C-clamp at each end

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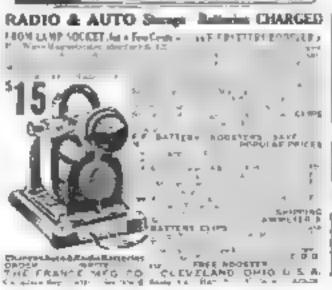
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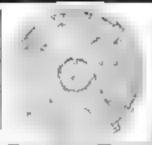
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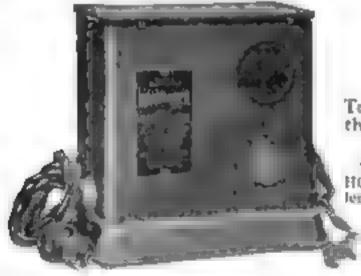
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THE HOME HORKSHOP

Crokinole-Carom-Checker Board

Continued from page 76

will not cut through the hoard the first time you run your knife across it, and probably not the second time, but it is not necessary to cut it entirely through. After you have cut it halfway through, bend the piece over, and it will break along the line of cutting. The rough, broken edges can be smoothed with sandpaper or a file.

When you have out the corner pocket openings out of the piece A, prepare the center circular piece, B, Fig. 8. The best compass for drawing the circles on this piece is a strip of cardboard with a pin or brad stuck through it near one end for a center, and holes punched at the correct radial distances, through which to insert a pencipoint. You will notice that there is a center circle I 🛂 in, in diameter, the wal board inaide of this circle is to be cut out. Then there is a circle 2 in. in diameter around which the holes for eight pegs are to be located. The two outer circles should not be drawn until the board has been assembled and painted

The pega must be fastened in board B before it is glued to board A, because these pegs are roofing main, D, Fig. 4, that run through the board from the under ade.

Plamber's *,-in Juher balls, E used for faucets, are glued to the nail ends. The large heads of the roofing nails must be set flush with the under surface of the board, therefore you must cut away the wallboard to form pockets of the right size to receive them. Space the pegholes equidatantly, You may find the holes in



Pig. 4 Page

the fuller balls too large for the nail ands. so first wrap strips of paper coated with glue around the nails.

Carpenter's hot glue is best for fastening the two boards together, but lacking this you can use inquid glue. The glue must be thin shough to spread readily, and it must be coated on the surface of each board. As soon as it is applied, bring the surfaces into contact, place the boards flat upon the floor or a table, and pile enough books or other weights on top to keep the surfaces in close contact until the glue has set. Board R must be centered exactly on board A, and it must be turned so that a pair of the pegs E are parallel to each edge of board A, as shown in Fig. 8.

Gluing the Rims

When the boards have been glued up prepare the rim strips, C. These must be grooved to receive the edges of board A. The grooves are easily cut with a 14-in. chied. The ends of the strips are mitered to join like picture frames. Be careful not to trim them too short, for the board will then spread the joints. Cost the edges of the board and the grooves with glue, set the board in the grooves, and glue and heal the mitered strip ends.

The boards require several costs of enamel. Enamel the rim strips and the circular playingboard red, the balance of the surfaces on both sides of the board yellow. When the enamel has dried, describe the circles on the circular board as located in Fig. 5. These circles can be drawn first in pencil, then with a small brush and black

(Continued on page 97)

THE HOME WORKSHOP

Best Home Workshop Ideas Win a Bonus

THE January "Best Idea" prizes are awarded as follows.
FIRST PRIZE \$.5: Joe V.
Romig, Allentown, Pa., "'Universa,'
Machine Gives Wide Range of

Service" (use page 78).

SECOND PRIZE, \$10: L. C. Porter, Cedar Grove, N. J., "Every Room in the House Wired for Radio and Call Bell" (see page 106).

The prize-winning articles, as will be noted, are original and essentially practical. Mr. Romig, in designing a stuple, general utility machine for the home machine shop, has performed a real services. It is hoped that other readers ill contribute material of equal value in regard to small, inexpensive machines for the home workshop.

Remember that these prizes are awarded each month and are a honus given in addition to space rates.

Crokinole-Carom-Checker Board

Con used from page un.

paint go over the lines, making strips 3f-in. wide. On the outer circle you will see four short lines. These divide the crokingle starting line so that each player will know his bounds. Locate the points by drawing diagonals through the corners of the board.

Figure 2 shows how to lay out the checker board. Mark off the checker squares

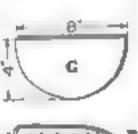






Fig 4. The pockets

with a pencil, then fill in alternate aquares with red paint, and the remaining aquares with black paint. The line outside of the checker board field is the starting line for the game of caroma and other games.

The corner pockets, Fig. 5, have heavy wire frames, F, to fit the grooves in the rim strips, and are curved to ant the circular openings. The pockets

are made of two pieces of light weight cloth cut like G, Fig. 5, sewed together around the edges and bernmed at the top.

The crokenule and checker dash are cut from a curtain or rug pole 1%-in. in diameter, H, Fig. 6. Mark off 7 16-in, spaces along the pole, then cut the disks carefully along the lines. Any disk found to be too

thick can be rubbed down to the right size with sandpoper, those too thin should be discarded Twenty-four per-



Fig 6. Chackers and couldingly pieces

fect disks are required, and it is best to make several additional ones to replace any that may be lost. Ensuel one half of the number of disks red, the other half black. The disks should be smooth, so they will saide over the board's surface. If they are rough, sandpaper the paint lightly and apply another coat

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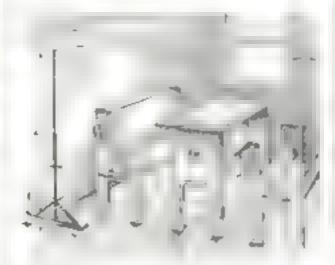
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Convenient Breakfast Nook in Its Simplest Form

ONE of the simplest breakfast nooks that can be constructed by the home worker serves as well as a more elaborate, built-in Pullman breakfast corner

For the space for the table and benches I chose a corner of the kitchen lighted by a large window. It was abut off from the

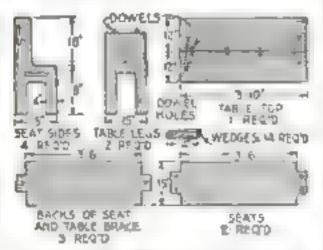


The tenon and under construction makes it peakship to take apart the benches and table for moving

rest of the kitchen by a portable frame covered with heavy wallboard, used to form an alcove.

Two long benchlike seats were made in the plainest possible manner by pinning a seat and a back to two side pieces with wedges, as shown. The table was made in a similar fashlon, a top being acrewed solidly to the legs and the whole braced by a center mil. Tenons at the ends of the rail pass through the mortises in the legs and are held by wedges in the same manner so the seat members.

Plain white pine was used throughout, the stock being 146 in, thick except the bench ends, which were 146 in, and the



How the few personally parts are cut from \$6- and \$4-in. beards 15 in. wide

screen frame, if in. The blocks at the base of the screen were heavier stock for the sake of stability. The entire mook was painted cream white with a simple blue border on the edges of the seats and table.

Not only has the arrangement proved a great convenience, but it also has the additional advantage of being readily removable in case of necessity.—G. L.

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Don't Blame It On Static!

The Real Explanation of Much of the Trouble You Have with Your Radio Set

By J. C. Shaw

One of the things which the radio world is rapidly learning is that the term "static" has been very loosely used to cover a multitude of radio sins for which static is really in no way responsible.

It is discovering that many of the frying, crackling noises and much of the so-called interference laid at static's door are due to nothing more or less than the use of batternes of the wrong kind or that leak an excessive amount of

electricity.

Any one of these battery faults can undo the most careful work in construction of set and aerials, and usually not only one but two or three of them are

present in the same place.

Radio operators should remember particularly that "B" batteries are in series with the phones or amplifying horn and that any noises set up within the "B" batteries themselves will come in strong. You can demonstrate this to yourself by scratching your "B" batteries with your finger-nail. The noise you get through your phones will surprise you,

A growing understanding of these facts is leading to much greater care in the selection of batteries and to the use of high-grade storage batteries for both A and B work, since such storage batteries have just the characteristics needed for both efficiency and economy

in radio service

An interesting development in this connection is the new type of "B' battery and an all-rubber "A" battery put on the market by the Willard Company. In these batteries, electrical leakage, which is present to such a great extent in the ordinary battery and which accounts for so much goise, is to a great extent ingeniously overcome.

The "B" battery cells are cylindrical glass jars with hard-rubber, screwed-oncovers. These are so spaced that the only contact between cells is through heavy, burned-on connectors. sealing compound is used and the box is cut down so that the sides reach up only about half way to the tops of the jars,

These features and the use of threaded-rubber insulation, operators find, result in a battery which holds its voltage, is never sluggish and, with occasional recharging, lasts for years. The writer has seen this Willard "B" battery in use on different sets and has been greatly impressed with the way in which it adds to range and power, and cuts out noises.

Inasmuch as this big improvement can be effected at an actual saving of money because of the long life of a really good storage battery, there is no question that this type of battery will rapidly be adopted for a great majority of sets. When this is done, the bugaboo of "static" will lose much of its

terror.—(Advertisement.)

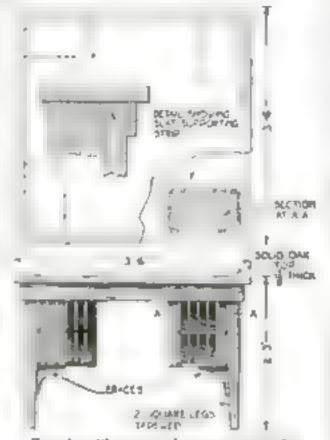
THE ROME WORKSHOP

Children's Study Table Makes "Home Work" a Pleasure

By Dale R. Van Horn

THIS study table is especially adapted to the needs of the average family in which from two to four growing children require a convenient and somewhat secluded place for doing their home lemons in the evening. Each of the four sides is provided with an individual compartment for books, papers and writing materials, and the whole arrangement is one to encourage

The top, which is 8 ft. 6 is aquare, is gived up solidly from 1% in, oak or other hard wood. Use at least 4 dowels in each



Four handily arranged compartments for backs and writing materials are grantifed

joint. The legs are shaped up from 2-in. square stock, 2 ft. 13 in. long. If stock of this size is not available, the legs can be glued up from 34 or 114 in, boards. The rails are 14 by 3 in., and the compartments are formed by alata 🔩 or 🐔 in, thick and 2 in, wide, acrewed to the rails and shelves.

The table top should be attached to the rails from underneath, either by means of regular table top fasteners or wooden blocks. A strip fastened to the under side of the table supports the slats at the back and inside end of each compartment. The braces, cut as shown, or in some other ornamental shape, are screwed in place beneath the lower shelves.

In finishing the table, the top should be scraped and the whole sandpapered carefully and then given a coat of filler and (several coats of shellar or a good commercial various stain. Other methods of finishing that may be used, if preferred, are to sheller and wax it, stain and wax it, or give it the standard and most durable combination of stain, filler, shellac, and varnub.

Small Soldering Copper Holds Heat Better when Wire Wound

TO MAKE it possible to retain heat in a small soldering copper, soft wire may be wound around the square body and part of the shank. This will add considerably to the weight of the copper and it will not lose its best so quickly.—R. G.



For Young and Old

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"Go North, Young Man!"

(Continued from page 25)

half of Alaska, and wheat near the Mackennie, north of Great Slave Lake, truck gardening can hardly be said to pay when there is another much more profitable use to which the land can be put-that of raising meat. Just us in New York, the corner of Broad and Wall streets would make a neat little garden plot, but the owner finds he makes rather more out of it if he puts up a skyseraper and rents out offices. So with the North. You can produce beef there to much greater advantage than beans.

About 26 years ago the American government imported into Alaska about 1200 reindeer to stock a ranch. Today those reindeer have multiplied until there are now more than 200,000 of them, in spite of the fact that more than 100,000 have been butchered and the carcames shipped south to cities where the meat has sold as a luxury. At present the reindeer industry in Alaska is a government monopoly, but Canada, with many times the grazing area. is upon to the astute pettler. It contapractically nothing to rame resideer. With the aid of dogs one man can berd at many as 1500 animals, just as sheep are herded.

Outbox Wool Does Not Shrink

Like the reindeer, the hairy, oxlike Ovibna musk-ox) is a valuable native of the north country. We are experimenting now with Ovibos wool, and find that it makes excellent cloth, with the added advantage that the cioth does not shrink when wet, And where is there not a market for unshrinkable woolen goods?

But in other ways apart from industry you must fit yourself to Nature to be a successful settler in the Far North. First, you must provide against the cold of winter, You must abandon fashion for warmth The sweater, which gives little real protection against the cold and blowing snow, must give way to furs. Your hands and feet must have perviceable coverings far removed from the orthodox gloves or leather abone.

The settler must live in a different kind of house too. In the Mackennie delta, along the shores of the Arctic Ocean, we built nod houses that gave perfect comfort, They are built with a framework of wood, and walled up with gods several inches thick, making them warm as toust in winter, and cool in the summer when the sup does not set for days. Of course, these houses are not very beautiful, but beauty won't belp you very much when the thermometer drops below zero, or when it shoots above 90 in the shade, as it occasionally does in the summer.

Eskimos Imitate the White Man

In places like Herschel Island, where the white man has been for a long time, I found that the Eskimos, who formerly lived comfortably in tents, are now converted to the white man's frame house, because they think it is more "civilized" and fashionable. The Eckumon, a childlike people, are quick to follow a fad, however unfitted it may be to their needs. The result of this change of quarters is to give them habitations that are hard to beat, even when kept almost airtight (I even found the keyholes stopped upwith chewing gum in the homes of some of the "best citizens" of the Eskimoo), and that are unanitary germ breeders.

Continued on toge 1911)

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"Go North, Young Man!"

Continued from page 100

To colonize in the Far North, you must get rid of a lot of false fears. When I first went to the Arctic, I was obsessed with a fear of the long winters. But in the years I have spent there I have learned that this fear was needless. We all enjoy sleighrides, toboganning, skating, house parties and smokers after dark in America. Why should the fact that we are north of the Arctic Circle take all the joy out of life.

The man who can rad his mind of some of these popular misconceptions can get along very comfortably and profitably in the north. It's an easy place to live in, a place where getting your food is sport. The chmate is atimulating and bracing, you feel like doing four times the work you do in the States. Life is cut to ementials. Yet you can have many of the desirable things of civilization, plenty of open air, food, warmclothing, adventure, contact with strange but pleasant natives - the Eskimos, when you get to know them and their ways, are as charming friends as I have ever made All these things are yours. And you don't have the crowds, the noise, the struggle to get money and outdo your neighbor, the dirt and disease of a great city

Hidden Wealth of the Arctic

And the material advantages? Well, the North is destined to become the great meatraising center of the world. The cost of rathing reindeer is no small that shipping the meat south will not a yearly increasing profit, Oil has been struck at Fort Norman, and prosperous cities are bound to follow. Manneapolis grew up in a very similar climate. There is coal in the Parry Peninsula, in Melville Island, Lougheed Island and Banks Island. Also there is iron in many places. In Victoria Island and around Buthurst Inlet there is copper It is easy to imagine Pitteburghs and Birminghams springing up close to the Arctic Circle some day

Just now the chief renources are fure and fish; tomorrow it may be oil and minerals, and meat-above all, meat? The time will come when large tracts of grazing land in the United States will disappear and when we shall have to look elsewhere for our meat supply. The ranches of the West are growing fewer and fewer already. We need the ground for forms—to raise cotton and grapefruit in Texas, corn and hogs in lowa, wheat in Minnesota and Manstoba and Saskatchewan, and apples in the northwest The grazing must be done somewhere else where vegetables, fruits, and cereals cannot profitably be raused. And that comewhere else is the rolling prairies of the polar shores.

The World's Meat Market

Economically, the Far North's greatest contributions to civilization will lie in adving the evergrowing food problem of the world. Reindeer, already a favorite meat in many parts of Europe, and served as a juxury in the clubs and hotels of a few great American cities, will find its way ultimately to every table in the land.

The rapidly increasing population of civdized centers must not only be fed, but must have room to apread out. In the North is plenty of room; three fourths of Canada and much of Alaska are awaiting settlement. Don't forget that, square mile for square mile, Canada is a larger land

(Cantinued on page 102)

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An official list of the nine districts of all amateurs, special amateurs and broadcasting stations of United States and Canada, also a large map, size 24 x 36 inches printed in two colors, showing location of every broadcasting station in United States and Canada; change of time area and location of each of the nine districts,

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He who smokes last smokes best

Wherein our correspondent takes a long shot at Zanesville, O.

When we printed a letter from a smoker who professed a preference for the early morning smoke, apparently we started something. Almost the next mail brought along a batch of letters, among which the following is a fuir sample

Dear Stee:

It is out allow me to take bone with tour

A. K. K. Irona Zanesville, who is the is

best pipe of the day is the one smoked right
after breakfast?

Of course I have no in mate knowledge of local constitues down to become to to list up here be one of you do sell as copie bimokers have a do not be become sowers a the

Minches have a do not be beening toward a the sast care of percentage.

There a not a terminate of the first at the first a percentage to a be according to the desire the same and the modeling to a construction and the modeline as a large a strong to one fast another. Since you are a strong to one fast another and you have not your pipe and tight up. You enable at we not penciously, calling out at laterals that you don't pencion the last son keep that I the bowl of your pipe.

That's my like of the best mode of the day.

the age for every another A B B care products who there are given a dear meet which the care are a dear meet which prefer the meet one be done on A d West of us are Edgeworth smoke v Valide very sincerel (Signed T S E of

Signed New York City.

Yes, as we suggested above, when we gave space to an expression of opinion

> about which is the best pipe of the day, westarted something but we are glad to e len our columns to friendly thereesto a a mut pipes and sutuking in general. So if you have any

particular rotpormits appriar cies, send them along. He are taking a neitral stan port our selves and expoacting an referees an the debate.

And if you aren't an Edgeworth emoker,

be sure and tell in about it. For we want to send you free samples, generous be a rogs both of Edgeworth Plug Slice and Rearly Rubbed.

EDGEWORTH

I tgeworth is sold in various sizes to ruit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket size packages, in handsome tinhamidors, and also in various handy is-Between sizes.

For the free samples address Larus & Brother Company, 59 South 21st Street Richmond, Va. If you will also add the name of the dealer to whom you will go if you should like Edgeworth, we would appreciate that courtesy on your part.

To Retail Tobacco Merchants: If your pobler cannot supply you with Edgeworth. Larus & Brother Company will gladly send you prepaid by parcel post a oneor two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber

"Go North, Young Man"

(Continued from page 101)

than the United States. If you should drop Texas, the largest state in the Union, into northern Canada, you could hardly find it. The distance from Nome to Sitka, Alaska, is as great as the distance from New York to Omaha. So there's plainly plenty of room to move about in

Finally, certain important political resuits are sure to fellow colonization of the North. When Canada is settled from south to north as it has been from east to west, it will run the United States a close second in wealth and population.

The North will reward the preneer, in each and spirit, fully as richly as have the great plains of our own "Wild West,"

Will There Be a \$150 Car?

Continued from page 01,

worn out, simply because the wear is confined to moving parts. It would be desirable to design the \$150 car so that it would run for four years without extensive overhauling. At the end of that time it could he sold back to the manufacturer at the rate of two cents a pound, or \$20. Thus, expensive adjustments could be ignored during the life of the car.

When a car is worn out, there are many Important as well as minor units that are invariably as good as new, such as the erankease, flywheel, transmission case, connecting rods, pedals and levers, propeller ahafta, drive shafta, steering wheel spider and strong linkage. Whenever an owner should sell his ear back, it would be forwarded to the assembly depot. Those parts that passed inspection would be used again, while the worn parts would still be worth their cost as acrap metal. The scrap would then be sorted into cast from and steel, broken up and melted—a process far less wasteful than the present methods of junking.

in estima it would be feasible to build public garages especially designed for these small machines at a cost approximately one fourth that of the average present day garage building

These are more than possibilities—and if Durant, Ford, and other geniuses of the automobile world know what they are talking about, the \$150 car will be with us within the time that it took Ford to reduce the price of his car from \$1000 to about one fourth that amount

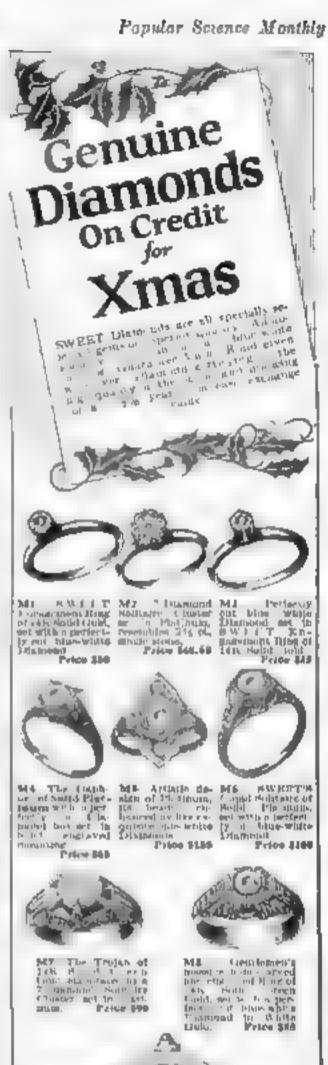
Camera Contest Prizes

AWARDING of praces thus month on POPULAR SCIENCE MONTHLY & \$500 prize camera contest marks the close of an interesting 10-month competition in which \$50 in cash prizes was awarded each month for the three best photographs of subjects of scientific and machanical interest. The prize-winners for January are

FIRST PRIZE, \$25-C. M Vaiden, San Diego, Calif. Subject "Thrilling Raze with Flood Saves Cost of Dam' unce page 43

SECOND PRIZE, \$15-C.W. Selta. Hilladale, Mich. Subject. "Harnesed Mod Turtles Clean Clogged Drasts in Michigan Town" (see page 46)

THIRD PRIZE \$10-A. K. Chenowith, London, Ohio. Subject: "Mechanical Harvest Hand for Hay Wagon" (see page 54)





515 - Lactice' fine: 15-Devel Weigh War ch with Sug-pulon sext of the one to are life financieting a col-case of 14K, Spital Whitee Contain tail transfers against tent to for case plan.

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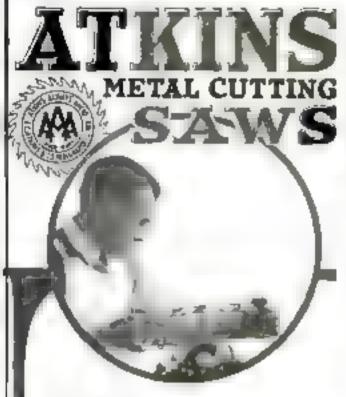
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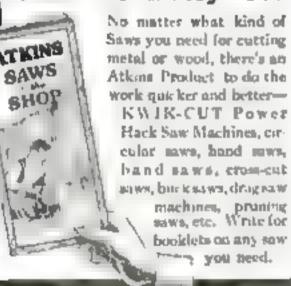


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Makers of "Stiver-Steel" Sows and Tools sold by Leading Hardware Desires and Jobbers, Mill Supply Houses and Facinty Branches all over the World,

Jack Binns' Radio Rules

(Continued from page 71)

and honeycomb coil mountings where two coils can either be moved apart from each other or turned around at various angles to each other. The operation of these two instruments easily explains the method of varying the inductive relationship between two coils.

7. Remember the Tickler Is Married to the Tuner

One of the most puszing questions to the average radio fan is the correct ratio of turns in the tickler to those in the tuning cod. As a general principle, you cannot go wrong if you adopt a ratio of 1.14 to one in favor of the tickler coil where the latter is of fixed value and its variation is made by changing its angle in respect to the tuning coil. This means that if the tuner has 50 turns, the tickler should have 75.

Where the tickler is stationary in relation to the tuning coil, the tickler should be tapped in the same manner as is the tuning coil. These taps should be joined to contact study in the usual manner and then the regenerative effect can be controlled by varying the number of turns in the feedliack circuit. The tube can be prevented from oscillating by reducing the amount of current flowing through the filament.

If you are building your own regenerative set and are in doubt about the exact ratio, remember that an ordinary short wave variometer makes an excellent tickler coil. All that is necessary is to connect it with the plate circuit of the vacuum tube detector and then place it alongside the tuning coil.

If there should be no regenerative action from the variometer, its connections should be reversed. The amount of regeneration in this case can be adjusted by varying the rotor of the variometer.

8. Learn the Function of Condensers.

There are two terms used in connection with a condenser that my correspondents find perplexing—"bridging condenser" and "bypass condenser." Both terms apply to one and the same instrument. It is no different from any other condenser, and a simply put into the circuit to permit is ghifrequency currents to pass easily by what would otherwise be an obstacle

To explain: Consider the telephones. The windings around the coils inside telephones offer high resistance, or impedance, to high frequency currents. If a condenser is placed across the telephones, the impedance is immediately reduced to a minimum and the higher the frequency of the current, the easier it will pass through the

We can understand the function better if we consider the action of a condenser. We know that it consists of two sets of plates separated by an air space or other dielectric. Now, at the instant a direct current is applied to the condenser, there will be a short passage of current. But when the condenser is charged to its maximum, there will be no further current flow. If we reverse the current, there will be momentary current flow in the opposite direction.

If we use alternating current, thus charging and discharging will occur at a rate corresponding to the frequency of the current used. At the moments when the current is at zero, there will be no passage through the condenser. It will be zeen, therefore, that the more rapidly the current

(Continued on page 104)



\$1,000 REWARD!

I've dirty, forlors shack by the river's edge they found the mutilated body of Genevieve Martin. Her pretty face was swollen and distorted. Marks on the slender throat showed that she had been brutally choked to death. Who had committed this ghartly crime? No one had seen the gul and her assailant enter the cottage, no one had seen the marderer depart. How could be be brought to justice?

Corner has him have been adved are the good dever day to hong. It is the set of the powers of expension hear day as seen in the powers of expension hear day as is a rise they seek to the line between the thick of the accitement, the beases of the later.

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Here's a big new development in a Punch Press Counter a heavy-cased ratchet mechanism, immensely durable



Built especially for recording the product of punch present metal stamping machine and other heavy-outy machine ery. Strong stops limit the movement of the lever to 45 degrees or 1 a harry which registers one on the dist. The large, legible figures are easily read tenfeet away Counter in regularly furmatted with five-figure wheels, and may be set lock to sare by one turn of knots. Requires no special fintures for attaching. Price \$18.00.

The Revolution Set-Back Counter below records the output of any muchine where a shalt-revolution indicates on



Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheele, as required. Price with low figure-wheels, as distracted, \$10.00---mbject to descount. Cut less than one-half size. Set-Back Rotary Ratchet Counter, to record reciprocating movements as no punch presses, \$11.50 (list),

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The Veeder Mfg.Co., 44 Surgeant St., Hartford, Conn.

Jack Binns' Radio Rules

(Continued from page 103)

is alternating, the more readily it will pass through the condenser. Since broadcasting by radio in usually done on \$60-meter waves and the frequency with which the current alternates is 833,333 cycles a second, it will be seen that the condenser plays an important part as a bypath of low impedance for these currents.

9. Treat Your Neighbor as You, Yourself Would Be Treated

Remember that your regenerative recerver under certain conditions in a weak transmitter of radio waves, especially if it is of a single circuit type. It radiates energy just the same as the broadcasting station. The moment you turn your filament on full, producing the beterodyne effect already explained, you are transmit ing a carrier wave that will seriously interfere with other neighboring receiving sets. If your set is not correctly adjusted to the same wave length as the broadcasting station, your wave will beterodyne upon the wave sent out by the latter and the clash will be recorded on every other receiver within neveral blocks. This means that the enjoyment of your neighborn will be seriously interfered with. Therefore don't turn your set into a transmitter.

10. Learn to Use the Triple Turned Regeneralise Receiser.

Many funs ask me how it in that the variocoupler-two-variometer type of receiver gives regeneration when there is no inductive relationship between the plate circuit and the tuning circuit. Remember that there are two ways of obtaining generation, first by means of an inductive coupling, where two coils are placed in an inductive relationship, and second by means of a capacitative coupling where the coupling element in a condenser. The simplest regenerative connection of all is a condensor joined to the grid and plate ter-

To a certain extent the variocouplertwo-variameter circuit is capacitatively coupled in that it utilizes the internal especity of the vacuum tube itself in conjunction with the inductances in the grid and plate circuits. These inductances are, of course, the two variameters. The regeneration occurs when both are tuned in exact resonance with the frequency of the

minals of the vacuum tube. This, however,

incoming argual.

in not entirely efficient.

The variocoupler-two-variometer type of receiver to the most efficient in eliminating interference, but of course it is a little more difficult for the average novice to adjust.

Gasoline Used to Draw Tracings

ROUGH pencil tracings of drawings, maps, and diagrams can be made on opaque paper without the aid of carbon paper or other transfer mediums if a little gusoline or benume is available

Tack the paper over the original drawing and pour some gasoline on it from a safety container or small bottle. This will render the paper sufficiently transparent to make the drawing below visible through it.

You will find that the gasoline quickly evaporates, so that you must trace rapidly or wet the paper over again with gasoline. It as advasable to trace only a small area at a time. When evaporated, the gasoline leaves no trace and in no way injures either drawing .- C. NYE.



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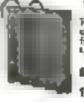
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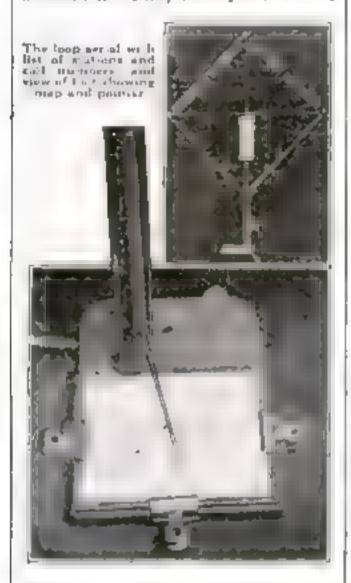
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THE HOME WORKSHOP

Direction Finder and Map Aid in Use of Loop Aerial

SINCE loop serials must be turned in the direction of the radio broadcasting station that it is desired to tune in, a direction finder and broadcasting map similar to the one illustrated is a useful addition to the radio fan's equipment.

A small platform is attached to the hane of the loop serial stand and upon it is mounted a broadcasting map correctly oriented. A pointer fixed to the revolving standard of the loop serial just above the



map is set by means of a pocket compans and used as a guide in turning the coil in the direction of the sending station. In some cases it is necessary to have the map arranged so that the shaft is in the center, this is when there are transmitting stations on all sides of the loop.

In the pictured installation the sending stations are identified by numbers on the map and corresponding numbers on a list of stations, call numbers, and other data fastened to a clip board that is mounted higher up on the loop standard,—John A. Manon, Baltimore, Md.

Old Bicycle Inner Tube Renews Life of Typewriter Roller

WHEN I discovered that the rubber roller on my typewriter was so hard that the heads of the type bars were in danger of being broken off through striking the unyielding surface, I cast about for a way to provide a softer platen without the necessity of sending the machine to the factory for repairs.

I bought on old inner tube at a bicycle repair shop for 25 cents, cut off a piece 12 in long, turned it inside out, pulled it over the roller and cut off the ends. The tube needs to be slightly smaller than the roller so that it will be atretched a trifle when in place. This repair has given entire satisfaction.—G. D. Shart, Minot, N. D.

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Read these over one by one. You'll be amazed to find such features in popular-priced under-wear.

1 Hannt Stantch Electic Shouldoes are made with acretic-doubling up seen. They fit right, with plenty of "give" for every motion.

2 Hases Tailored Collarette non't pip or roll. Fits analy amend your proll always, and keeps the wind out.

3 Hance Electic Cuffs are made are stronger and better than the tenth cult. They fit the trist fitting and won't flare or rip from the sleeve,

4 Hunor Closed Crutch is cut and attriched in a special way that really keeps is closed.

5 Hange Elastic Anklos held their though reposted washing. They never bunch swit your shoes, but it always.

every strain-point ed and is guaran-

THEN consider that every strain-point is strongly reinforced and is guaranteed to hold fast. That the flat, non-irritating seams are guaranteed not to break. That the fine quality buttons are guaranteed to stay put. That the buttonholes are guaranteed to keep their shape.

Bear in mind, too, that Hanes Winter Underwear is made of fine, fleecy cotton that keeps out cold. It's cut and tailored to fit. It snugs close, but without the slightest pulling or binding.

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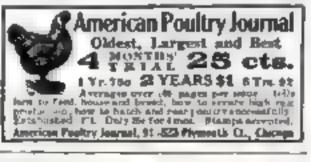
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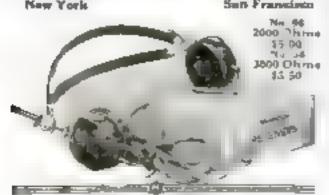
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THE HOME WORKSHOP

Every Room in the House Wired for Radio and Call Bell

By L. C. Porter

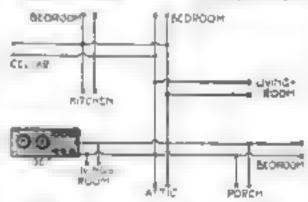
HE pleasure and educational benefit from broadcasted radio programs so appealed to me that I had every room in tay house wired for radio. Later the same wiring was utilized for an emergency call system from one room to another

If my family chooses to sit on the front porch, the music is with us. If we are weahing dishes in the kitchen, there, too, we may have music, lectures, sporting results, and the like. It takes but a few seconds to change the phone from one room to another.

Contrary to the general impression, a loudspeaker does not have to be located at or close to the radio receiving set. It may be placed at almost any desired distance



from the set and connected with It by means of ordinary bell wire. Neither is it necessary to have a large or expensive horn. A cone of and brown paper rolled up ao that it is about 6 in, long, 4 ln. in dameter at the mouth, and by in.



Wirley diagram and the box used in connection with call bell system

in diameter at the throat, will give eatisfactory results. A 25-cent megaphone, such as is used at football games, with s type C Baldwin phone taped to the end makes a good laudspeaker

I ran a pair of No. 18 bell wires from my radio set to every room in my home, as well as the attic, the cellar workshop, and the front porch. These wires terminated in each room in a pair of binding posts set into a small block of wood nailed to the trim. Over each pair of binding posts a cup book was screwed into the wall about 7 ft. above the floor to hold the loudspeaker and horn out of the way. The receiver was placed permanently in the living room, connected by leads through the floor with the storage buttery in the cellar. A single point switch was arranged for disconnecting the radio instrument, when desired.

The same wiring is used as a call system. Two standard dry cells are kept in a wooden box with a doorbell and a small switch on the outside. About 4 ft. of ordinary lamp cord are connected with these. A pushbutton is attached to one end of another 4-ft cord. Therefore, if the bell is attached to any pair of binding posts, and the pushbutton to any other set, pushing the button will ring the bell. This is a great convenience in case of Illness, because the pushbutton can be placed beside the patient's bed and the bell in the kitchen.

THE HOME WORKSHOP

Homemade B Battery Reduces Noises of Detector Tube By C. H. Ward

FROM the number of different makes and types of radio B batteries sold, it is evident that the last word on plate voltage supply has not been said and probably will not be until a saturactory device is perfected for the direct use of 110 a.c.

For detector operation I stumbled upon what appears to be perfection in homemade batteries. Its cost is higher than a dry cell, but it is rechargeable and its very steady voltage and freedom from noise will justify the greater investment. Chemically, it is a copy of the Clark standard cell, hence its steady voltage. This is a little over 1.6 (1.43 in the stan-

dard cell, which uses sinc amalgam), so that 15 cells give amplo voltage for detector operation.

The cells are contained in 4-in. test tubes about 14 in. in diameter, mounted in a rack In the bottom of each tube in pinced a 1/2-in. layer of mercury for the positive pole, into which dips the connecting with from the next cell an shown On the mercury in placed a .ayer of depolarising paste about 134 in thick. This consists of zine and moreurous surphates finely ground together in the presence of a few draps of mercury. The powder is most tened with a saturated solution of zine sulphate, and enough of this solution added nearly to fill the tube. Evaporation and creening is prevented by a shallow layer of oil.

Runs Year without Recharging

The negative pole consists of a T-shaped piece of sheet zinc, the arms of which rest on the top of the tube. A piece of copperwire is soldered to the zinc at the top and passes down through a thin glass tube into the mercury of the next ceil. Rubber-covered wire may be used instead, provided the insulation is free from cracks.

This battery will last in moderate use for more than a year without recharging, and does not appreciably deteriorate. When it ceases to give service, it may be charged from any source of direct current at about 14 amp, until the line of separation between the mercury layer and the depolariser becomes once more distinct and the depolarizer is changed from a grayith color to white. This will take about 24 hours. As soon as the charge is finished, the sines should be removed and replaced with new ones, as the zine deposited during the charge is in a spongy state and upon discharge will drop off and foul the cell.

The size and details can be altered, but the relative proportions abould not be greatly changed. In any case, it is important that no part of the copper connecting wire come in contact with the electrolyte so as to permit current to flow from it to the zine during charging

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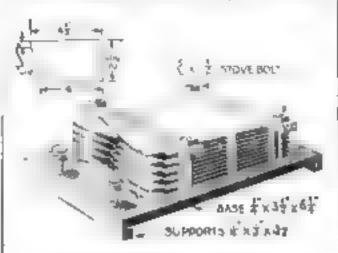
THE HOME WORKSHOP

Air Gap Telephone Condenser Improves Radio Reception

By Loyd B. Gangawere

BECAUSE of its efficiency, this conordinary phone condenser, is well worth constructing. The writer has tried it on several sets and it has always brought in clearer signals than the ordinary tinfoll and paraffin paper type.

Either 9 or 11 plates of sinc or sheet brass are cut as shown and 27 or 38 separators made of 1/32-in, sheet fiber 🎠 in, wide and



Zine or besse plates are esparated by fiber steeps or paraffined cardboard

214 in long. If fiber cannot be obtained, cardboard dipped in hot paratfin will

Two end separators are placed on the base, the first plate is laid on them, and two more and separators and the second plate are put down. This is continued until all the plates are stacked. It does not matter whether the acparators are in exactly the right position during the stack-

ing operation

The wooden clamps, 5,16 by by 834 in., are next placed in position and the bolts drawn up loosely. The plates are then pushed into place and the separators put in position with a table knife or old hacksaw blade. The stove bolts are tightened and the center separators placed in position with the aid of a knife or saw blade, A piece of wire is soldered to the ends of each series of plates and taken to binding

The condenser may, of course, be fastened directly to the back of a panel, instead of being mounted on a base

Storm Sash in Two Sections Opens for Ventilation

TO OBVIATE the difficulty of ventilating a room, the windows of which are closed by storm sash, an ingenious house-

holder uses a homemade two-piece storm each that m bluged at the center This arrangement permits lowering the top or rawing the bottom section of the sush, as illustrated, whenever it is descrable to air

The two sections of the combination sask are beld in place by hooks and eyes. The edges of the sash are covered with stripe of felt so as to form as nearly an airtight joint as possuble against the window frame.-G. H. DACY.



Photographic Transparencies Give Artistic Color Effects

By Herbert C. McKay

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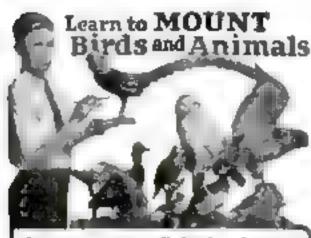
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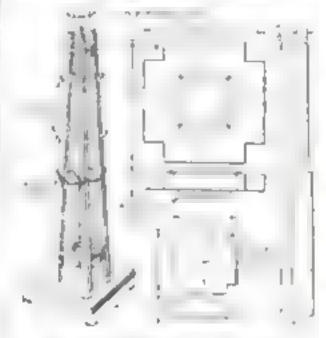
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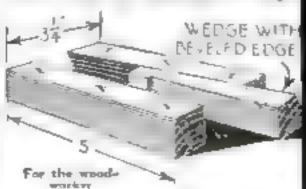


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Bench Stop with Beveled Slide Holds Work Rigidly

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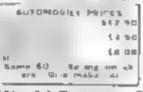




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THE HOME WORK TOP

"Universal" Machine Gives Wide Range of Service

(Continued front page 78)

being checked for accuracy before amembling. They are held apart by ½ by ½ by 3 m. pieces and ½ n. flathead acrews hold the amembly together. While the lower plate needs only to be flat, the top plate must be flat and straight as well. This should be checked with a micrometer and straight edge. Drill the holes for the ½-in. screws only 7/16 in. deep, so that they will not go through the top surface. In the lower plate are drilled 9/16-in, holes apaced 3 in, apart on the center line of the plate for the ½-in, bolts that clamp it firmly to the work plate.

A by-in. 20-thread feed screw as mounted between brant bearings that are screwed to the top plate. This feed screw is fitted with a ball crank handle. The nut is also of brain and is riveted to one of the angle

> precent that hold the head down on the shear plate.

The head itself in made of cast iron over a simple pattern that any mechanic can make. The

pattern splits in two on the vertical center line, shown in the end view of the bead detail. The custing is machined flat on its bottom surface, which is squared to exactly 6 in. The flatin spindle husbing holes, as well as the back shaft holes, are 2 in above the base and absolutely parallel with it and the sides.

Boring spiredly hales in lathe head with

weektable parallel to

The husbengs are turned from bronse and split, as shown, one cut going through and the other two stopping within 1,16 in of the inside bore. This arrangement, together with the split head bearing, makes it easy to take up the bearings for wear or adjustment. Thrust on the spindle is taken up by ample surfaces of the thrust collar on the spindle, which rides against the bushing.

The spindle is turned from machine steel and has a No 2 Morse taper. It is threaded on the noise end with 12 1 SS threads an inch. The drive gear is mounted on the spindle over a 14-in feather key and is held by the two lock collars. To the rear of the spindle is the back shaft upon which run the drive pinion and pulley. The back shaft is held in place by two 1, in setserews. In a drive reduction of from 1 to 3, a 12-pitch, 15-tooth pinion meshes with a

45-tooth genr. A detail of the pinion is included in the working drawing drawn to a scare twice as large as the rest of the details. The various easily obtainable gear ratios are given



Foring and of lathe with slab miller, the warktable being set crosswise

In the gear table.

Care should be exercised to preserve all the dimensions as shown, particularly the center to center distance of the two shafts. For heavy cuts use the 1 to 2 ratio; for medium, the 1 to 2 ratio, and for light cuts, the 1 to 1 ratio. When high speed is desired, as for drilling with small drills, or

Continued on page 112,



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THE HOME STORKSHOP

"Universal" Machine Gives Wide Range of Service

(Continued from page 111)

polishing work held in the chuck, use a 2 to I ratio by mounting a 20-tooth gear on the main spindle, and a 40-tooth gear on the back shaft.

A 32-in, wide belt drives the pulley from the countershaft overhead. The drum is made by mounting a section of galvanized iran pipe 3 in. in diameter on two wooden disks that are keyed to the shaft. It is necessary to cut down the speed of the motor, and the proper speed of the drum will vary with the metals on which the operator happens to be working. The two hest speeds for the drum are 30 and 75 r.p.m. These are obtained with suitable pulley combinations on the motor and countershafts. Sufficient power for driving the inserted cutter milling head shown is obtainable with the 1 to 5 gear ratio.

When the machine is used for drilling, boring, spot facing, counterboring, reaming, turning, polishing, and the like, the head is mounted parallel with the slide and is moved in and out on the slide with the foed screw mounted on the right side of the alide. A longitudinal travel of 8 in in obtainable and deep holes can be drilled or

Adjusting the "Universal" for Milling

When the machine is to be used for milling, the side angle plates are unacrewed and the bead is turned 90 degrees and again screwed up with the angle pieces. The head then hes across the shears and la ready to slab mill or face the flat surfaces of machine parts. Woodruff key cuttern and large end milis are held in a scroll chuck.

The inserted cutter head is used only for wide surface work. This head is threaded to fit the spandle and is fitted with 5, 16-in equare steel bits held by hollow head setacrews. The cutters must be sharpened alike so that each will do its share of the cutting. A 5 15/16-in, faceplate is a useful attachment, as well as a scroll chuck with reversible jawn.

When turning or boring work held in the chuck, the tool is clamped on an iron or steel block in the position desired and the work is fed into the tool. By blocking up the work to the necessary beight, the need of a vertical movement of the head is eliminated. When a job is to be hundled that is too high, the sade is set up on parallels to suit. Fly cutters held in short bars in the chuck make possible difficult milling operations, and many other arrangements of tools and set-ups will suggest themselves to the builder and user of this machine, With it as a starter the ingenious mechanic can build his own lathe and other small mochine tools.

Why Not Build a Cabinet for Your Radio Set?

IF YOU have a radio set, you should not must an article on building radio cabinets in the Home Workshop Department next month. It will gave a number of designs for homemade cabinets ranging from a simple stand to a magnificent large case with inlays and panels of burl walaut veneer

THE BOME WORKSHOP

Little Tots Have Endless Fun Playing with Dogmobile

HAVING built this nevelty dog for my boy, I thought that other fathers might like to make similar toys for their children.

The first step is to bey out and cut full size patterns from cardboard. This can best be done by taking one piece of cardboard 10 by 24 in., another 14 by 24 in., and a third 7 by 13 in., and dividing them.

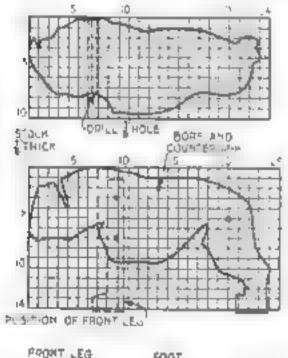
up into one inch squares. On the first lay out a pattern for the central body piece, which has the dog's tongue at one end and the tall at the other. This is the top pattern shown below The dotted lines represent the hole for the steering Use the ∎heft. second piece of cardboard for drawing the pattern of the body

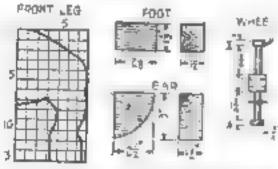


Riding the buildeg

proper and hind leg. Two wooden pieces will have to be cut from this pattern. On the third piece of cardboard lay out the front leg and cut two of them. Use \$\frac{1}{2}\$ in, pine, cypress, or other soft wood. The cut ting can be done with a coping-saw, keyhole saw, fretsaw or band saw. Freish the edges with a file and sandpaper.

It will also be necessary to cut two cars as shown, and two feet, 114 by 21 m., beveled a little on top, to be festened on





A pattern for the main body pieces can be laid out on paper or cardboard divided note l-lo. squares

the front leg, as will be seen in the top illustration.

Through the central body piece drill a 7 16-in, hole for the steering shaft, counter-

(Continued on page 114)

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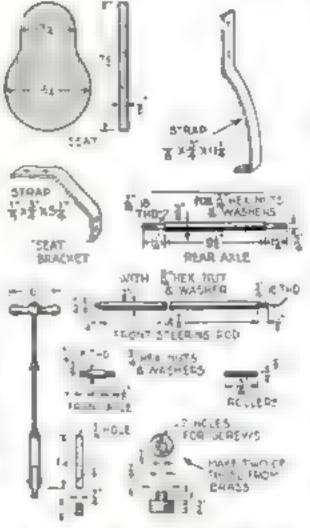
THE HUME BORKSHOP

Children Enjoy Dogmobile

(Continued from page 113).

minking it at the top and bottom for brass bearings. On the inside of the front legs bore &-in, holes and meert preces of &-in. round steel to serve as footrests. Screw the legs to the outside body pieces from the mude with flat head wood screws. Then screw the two outside body pieces to the central piece. Fasten the seat, cars, and feet in place with glue and screws, covering the screw heads with putty

Any convenient method of arranging the wheels and steering apparatus may be used. The wheels are of steel and ten pieces of



Details of the seat, brackets, year asle, frunt steering red front axis, rollers, and bearings

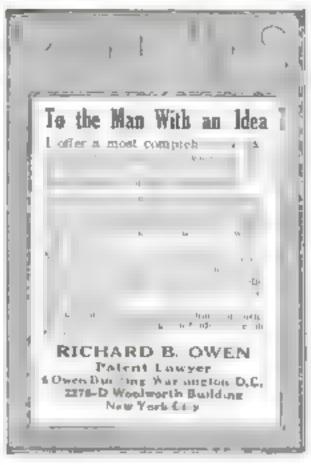
igin, steel rollers form roller bearings, a washer on each side of the wheel holding the rollers in place. Wooden wheels can he used, if more conveniently obtainable.

After the dog is assembled, give the body two coats of flat white and one of ename). and then paint the head, tail, seat, and middle parts black. Give the dog's tongue a coat of red paint.—Enwise W Hoseus. Cincinnati, O.

How to Restore Burned and Worn Soldering Irons

SOLDERING coppers, commonly called "irons," after being used a number of tumes, finally get into such a condition as to require filing into shape. The effects of frequent heating and cooling and the occasional burning of of the tin coating through overheating produce a sort of casehardening that prevents even a new file from having much effect.

After putting up with this for some time. the writer tried on old horseshoer's rasp, which has large rounded teeth. These cut right into the hard surface, but left it too rough for the tinning process. All the roughness, however, was easily filed amouth with an ordinary file, which was kept well offed, and cleaned frequently with a filecard .- W S. STANDIPORD, Youngstown, O.











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THE HOME WORKSHOP

How to Build Humidifiers

(Continued from page 7a)

tray is 11/4 in, deep and extends flush with the ends in front, or about 34 m. farther than the trays above.

The galvanised iron used in constructing the device may be any thickness from 24 to

30 gage

Water is poured into the top tray and it espeades down until all the shallow trays are filled, any excess running into the large tray at the bottom.

The air rises behind the lower tray to the space in back of the bank of trays. Since it cannot escape directly through the top because of the top piece, which in this case m 0 by 22 m., the air passes over the trays and is moustened by the water in them.

Trough and Wick Tupe

The second type makes use of cloths suspended between the upper and lower troughs in such a way that they are kept most by capillanty. The upper troughs are 14 in. wide and have one side 34 in. high and the other to in. high. Those are soldered in position between a front piece and a somewhat larger fitting trough 1/4 by 34 in,, which runs across the back. Holes are punched to allow the water to flow from this cross trough into the amuller ones

The lower system of troughs is exactly the same except that each small trough in centered under the 3,-in, edge of the corresponding trough above. This is made

clear in the illustration

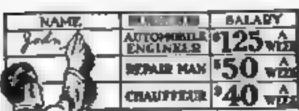
The upper and lower troughs are connected by means of cloths, which are hemmed at the top and bottom and have galvanized from rods in the home to hold clothe taut. Old bed sheets were found by Dr E P Lyon, the designer, to be excellent for this purpose, whereas cheesecloth did not work so well. The width of the clothe should be from 10 to 15 in.; anything in excess seems to reduce the efficiency of the apparatus because the cooling effect of evaporation interferes with the air currents.

Providing Water Supply

This kind of humidifier can be filled by hand and the excess from the lower cross trough drawn off through a subber tube into a large bottle or pail on the floor. Less attention is required if an inverted bottle in arranged, as in a poultry drinking fountain, to keep a constant level of water in the upper trough

To simplify further the work of attending to the humidifier, it is well to provide a small pipe from the house water supply or from a tank to the upper supply trough with a valve to cut down the flow of water to the requests amount. The excess can then be carried of by another pipe to a sink or the home drain. Very small pipe will serve for this purpose; even copper tubing used for automobile gas and oil lines. All that is necessary for humidifiers on the first floor of a house is to bore two holes for the pipes through the flooring, back of the radiator.

The simplest method of finishing the humidifier is to gild or cover it with paper to match the wall. A light wooden frame with grillwork along the lines of the door in a phonograph sound chamber can be constructed, if care is taken not to impede the circulation of air to any considerable extent



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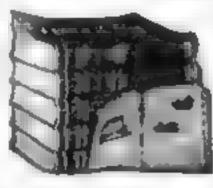
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Residence by

THE HOME WORKSHOP

Office Man Tells How He Built His Own Home

By R. J. Stophens, Rosedale, Kan.

(Submitted in the contest, "How I Made Money with My Tools")

WITH the skill in using tools that I had acquired in my home workshop. I built the home illustrated almost entirely by myself, with very little ready cash, and in the face of unexpectedly discouraging circumstances. The work was done in my spare time while I was employed as a credit man and accountant. My wife and I were able to raise the frame and complete the building in the early morning and evening, on holidays and during one week's vacation. It meant considerable self denial and hard work, but by keep-





The mea-man house when finished and the floor plan from which it was hull!

ing before us the vision of our home as we had first planned it on paper, we succeeded at last in freeing ourselves from the gailing yoke of the landlord.

To start with, we owned a 50-ft lot representing an investment of \$750. With what little we could acrape together and borrow on the lot we had about \$500 in cash and we figured that by economizing and taking our pleasure in planning and building the bouse instead of spending money for amusements, we could set uside a good part of my monthly salary for our building fund. So we obtained literature and books on home building and finally arrived at a plan of a house that could be constructed along simple I not without accrificing beauty and comfort, and I prepared working drawings.

A though I had been a clerical worker for 18 years and had never done mechanical work for a living, I had a fairly good set of tools and knew how to handle them, because I had always been making something for the house. To learn more about actual building construction, I made Sunday trips with my wife and baby to study new houses in course of construction, so

Continued on page 117)



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Swarn to and miscribed before me this skip day of October 1922

Paul V. Rome

(Seal) My Columbias pupites March 30, 2894

THE HOME WORK HOP

Office Man Builds His Home

(Continued from page 116

that before a sod was turned I knew axactly how our home was to be built from start to finish and how it would look when done, even to the color combinations.

We rented a cheap cottage with a goodsixed barn close to the property. I rigged up a workshop in the barn and made all the door and window frames, porch coltimes, porch and gable brackets, porch beams, and everything possible before commencing the house proper

The excavating work was done in July at a cost of \$35 and then, with the occasional assistance of my wife, I constructed the concrete forms for the foundation. I wanted to shun the concrete work, but the best figure on the job, material furnished, was \$400, so into the mammoth mold I wheeled and mixed by hand 40 ca. yds. of concrete. This cost about \$150.

Through August and September I worked on the frame and had the house under cover by October 17, ready for plumbing



The front and north and of hungalow

and plastering. At that time I fell from a scafford and broke a leg, and later my wife and baby were both periously III, so that work an the house was delayed until-the following summer. When the plumbers and plasterers had finished, I laid the oak floor and had it dressed with an electric sanding wheel at a cost of \$30. Then I finished the floors myself and we moved in There was no hunde trim, but the place looked well to us and, in spite of the handicaps of accident and illness, we were in our naw home in a little more than a year after we started it, and our rent stopped

House and Lot Cost \$3200

We kept books carefully so that we knew exactly what each item cost. By keeping constantly on the lookout for bargains in material, the entire rost, including the lot (but not interest on barrowed maney), was \$3200. No mill work was treed except sach and doors. The entire carpenter work, brickwork, concrete, painting and decorating, lighting, and even laying the terragge bath floor were done by the writer The pipeless furnace, which cost \$200, was installed by the dealer

It may seem impossible that I could finance the building of a home estimated conservatively at \$5000 on so little cash, but we had mestered the art of saving and economisting, and my credit was established with my bank and local dealers. We were able to divert at times as much as half my salary into the building fund. As our home neared completion and increased in value, the bank was ever ready to adeance the money, although the most I ever dwed was \$1000. It was difficult to satisfy my creditors at all times, but somehow or other I kept my appointments and paid them as agreed.

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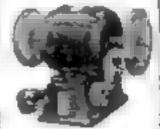
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The Shipshape Home How to Do the Odd Jobs

Repairing Pipes

A MATISFACTORY temporary repair of a leaking water or steam pipe, even if it is subject to considerable pressure,

may be made by wrapping the pipe with a long strip cut from an automobile inner tube. This should be stretched tight as the wrapping proceeds, and the rubber, when in place, should be covered with several layers of tire tape. This will last until the plumber comes.

To make a more permanent repair, the wrappings are bound as tightly as possible with wire and the ends of the wire are twisted together.-C. O. 80078, North Balem, Ind.

Stopping Leaks

LEAKS in the house water supply are often discovered when the water system is thowed out after baving been

badly frozen. The first thing to do is to shut off the water in the cellar and let the water drain from the house pipes as far as

possible by opening the faucets.

If a plumber cannot be had immediately, dry the pipe at the place where it is broken and smooth any rough edges. Cost the pipe with shellac and apply a patch of tough wrapping paper. Brush the patch with shellac and while it is drying prepare several strips of old cloth about 2 in, wide. Give the pipe another coat of shellar and wrap the strips around it like a surgeon's bandage. Fasien it with shelled or adhesive surgical tape.

Paraffin or melted candle grease will serve instead of shellar, but, in that case, the pipe to be mended should be warmed before applying it. -R. L. T.

Filling Cracks

HAVE found that cornstarch mixed with linseed oil to the consistency of a heavy dough makes a good

crack filler for floors. A small smount of drier may be added to hasten the drying.

This paste works better than putty and m cheaper than crack fillers on the market. It can be used without a putty knife by working it into the cracks with the thumb and then wiping up with a cloth small particles remaining on the surface.

The cracks should be cleaned out well and given a coat of oil or paint before anything is done. If the putty is next to the bare wood, the wood will absorb much of the oil with the result that the putty will work out of the cracks in tame. It is also necessary to see that all loose boards are nailed down before the cracks are treated with the cornstarch filter. - C. O S.

Finishing Asbestos

To urve a good finish to the asheston insulation used for boilers, apply a finishing coat of one part of plastic asbestos

and one part Portland cement mixed together. Further protection will be given the surface if it is puinted with a white lead off paint.—R. S.

FACA-F8D-MS2C



Copyriginal human

THE HOME WORKSHOP

Stand Set into Ironing Board Saves Effort

TO SAVE my wife the trouble of lifting a 6-ib, electric iron to and from its stand. I made a stand set flush into the ironing board as shown. The stand was cut from 1/16-in, copper to a size and shape approximately 1 in, larger all around than the bottom of the iron.

I crowned the plate up about 14 in. as shown, and then cut an opening in the



A slightly crowned copper plate is featened over opening out in froning board.

board 14 in. smaller all around than the copper. I receased the edges of this opening sufficiently to let the margin of the copper in flush with the top of the board. Several 34-in, holes for reptilation were drilled through the plate to prevent a hotair pocket being formed below.

Since the plate is growned, the iron does not touch the board itself even when it is not placed squarely on the plate and projects a trifle over the board.—Gronge

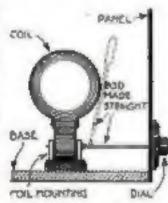
STRITZ, St. Louis, Mo.

Dial Knobs Will Control Triple Honeycomb Coil Mounting

IT IS not difficult to mount triple honeycomb coils back of the radio set panel in such a way that the adjustment can be made with knobs and disk. The only drawback lies in the necessity for opening the cabinet or reaching over the top of the

president when colls of wher sizes than those regularly conused have to be plugged into the mounting.

If the mounting in already on the front of the panel, remove it and straighten out the two control rods. Then drill two holes in the panel far enough up



holes in the panel The mounting is placed behind panel

from the bottom and the correct distance apart to allow the ends of the rods to be passed through them when the mounting is fastened to the base of the set. Two 45-degree dials and knobs are then fastened to the ends of the rods in front of the panel. It probably will be necessary to solder a length of brass tubing on each of the rod ends before fitting and attaching the dials.—E. C. DIFFINE, Tonawanda, N. Y.



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Young man, the only difference between a rot and the grave is that the grave is that the grave is deeper. I say, get out of the rut. Do the work you like. He independent. Learn a trade. Be a mechanic. Get into the auto business, You can care big money. You can travel and see the world.

I have belond \$0,000 men to success. This Million Dollar trade school is the greatest success factory you ever saw. The way to learn in easy. You don't need any experience. I teach with tools not books. You learn your trade by actually doing the work.

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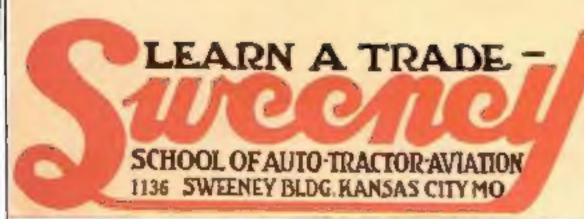
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